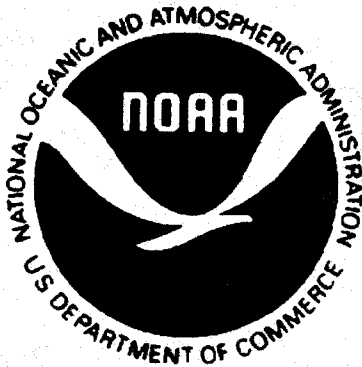


Steller Sea Lion Protection Measures Final Supplemental Environmental Impact Statement



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SEIS Chapters 4 - 7



Chapter 4 Environmental Consequences

This section forms the scientific and analytic basis for the issue comparisons across alternatives. As a starting point, each alternative under consideration is perceived as having the potential to significantly affect one or more components of the human environment. Significance is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring). Further tests of intensity include: (1) the potential for jeopardizing the sustainability of any target or non-target species; (2) substantial damage to ocean and coastal habitats and or essential fish habitat; (3) impacts on public health or safety; (4) impacts on endangered or threatened species, marine mammals, or critical habitat of these species; (5) cumulative adverse effects; (6) impacts on biodiversity and ecosystem function; (7) significant social or economic impacts; and (8) degree of controversy (NAO 216-6, Section 6.02).

Differences between direct and indirect effects are primarily linked to the time and place of impact. Direct effects are caused by the action and occur at the same time and place. Indirect effects occur later in time and/or further removed in distance from the direct effects (40 CFR 1508.27). For example, the direct effects of an alternative which lowers the harvest level of a targeted fishery could include a beneficial impact to the targeted stock of fish, a neutral impact on the ecosystem, and an adverse impact on net revenues to fishermen, while the indirect effects of that same alternative could include beneficial impacts on the ability of Steller sea lions to forage for prey, neutral impacts on incidental levels of prohibited species catch, and adverse impacts in the form of multiplier effects reducing employment and tax revenues to coastal fishing communities.

The terms "effects" and "impacts" were used interchangeably by analysts preparing these analyses. The CEQ regulations for implementing the procedural provisions of NEPA, also state "Effects and impacts as used in these regulations are synonymous." (40 CFR §1508.8). The terms "positive" and "beneficial", or "negative" and "adverse" are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

Though the intent of the alternative fishery management schemes being proposed is to mitigate potential impacts of the federally managed groundfish fisheries off Alaska on Steller sea lions, the effects of the alternatives must be evaluated for all resources, species, and issues that may directly or indirectly interact with this fisheries within the action area. The direction of intensity, therefore, applies to the particular resource, species, or issue being evaluated (as opposed to always applying to Steller sea lions).

Each section below contains an explanation of the criteria used to establish significance and a determination of significance, insignificance or unknown for each resource, species, or issue being treated. The criteria for significance and determinations of significance are summarized in a table in each section, or when the same criteria were used to evaluate subsequent species, the reader is referred back to the appropriate table. The following ratings for significance are used; significant (beneficial or adverse), conditionally significant (beneficial or adverse), insignificant, and unknown. Definitions of the criteria used for these rankings are included in each section. Where sufficient information is available, the discussions and rating criteria used are quantitative in nature. In other instances, where less information on the direct and indirect effects of the alternative are available, the discussions and rating criteria used are qualitative in nature. In instances where

criteria do determine an aspect of significance (significant negative, insignificant, or significant positive) because that aspect is not logically describable, no criteria are noted. These situations are termed "not applicable" or NA in the criteria tables. An example of an undescribable situation is evaluating the impact vector of incidental take on marine mammals. In that situation, criteria to determine significant adverse and insignificant are describable (though with less precision than perhaps desired by decision makers), however, within the band of effects known to be insignificant the point of no incidental take impact is reached, therefore, a criteria for significant beneficial is not applicable. Each resource section that follows contains a table summarizing the criteria used to determine significance for that particular resource.

The rating terminology used to determine significance are the same for each resource, species, or issue being treated, however, the basic "perspective" or "reference point" differs depending on the resource, species or issue being treated. Table 4.0-1 summarizes the reference points for the topics addressed in this analysis. The first three reference points relate to the biological environment, while the later two are associated with the human environment. Social and economic consequences are not listed because the significance ratings were not similarly applied; rather, direct indicators of changes from current economic conditions were used. For each application listed in Table 4.0-1, one to five specific questions were addressed in the analysis. In each case, the questions were fundamentally tied to the respective reference point. The generic definitions for the assigned ratings are as follows:

- S+ Significant beneficial effect in relation to the reference point; this determination is based on ample information and data and the judgement of the NMFS analysts who addressed the topic.
- S- Significant adverse effect in relation to the reference point and based on ample information and data and the judgement of the NMFS analysts who addressed the topic.
- CS+ Conditionally significant beneficial effect in relation to the reference point; this determination is lacking in quantitative data and information, however, the judgement of the NMFS analysts who addressed the topic is that the alternative will cause an improvement in the reference point condition.
- CS- Conditionally significant adverse effect in relation to the reference point; it is based on insufficient data and information, however, professional judgement is that the alternative will cause a decline in the reference point condition.
- I Insignificant effect in relation to the reference point; this determination is based upon information and data, along with the judgement of NMFS analysts, which suggests that the effects are small and within the "normal variability" surrounding the reference point.
- U Unknown effect in relation to the reference point; this determination is characterized by the absence of information and data. In instances where the information available is not adequate to assess the significance of the impacts on the resource, species, or issue, no significance determination was made, rather the particular resource, species, or issue was rated as unknown.

In this analysis we use the term "conditionally significant" to describe a significant impact that is informed by incomplete or unavailable information. The conditional qualifier implies that significance is assumed, based on the credible scientific information and professional judgement that are available, but more complete

information is needed for certainty. In other words, we may find that an impact has a significant adverse or a significant beneficial effect, but we do not have a high level of certainty about that finding. This approach provides a heightened sense of where information is lacking, and may guide research efforts in the future. An interesting point to make about this approach is that if an impact is rated as insignificant, there is a high level of confidence that the impact is truly insignificant, or it would have been moved to the "conditional significance" category.

Table 4.0-1 Reference points for significance determinations

Reference Point	Application
Current population trajectory or harvest rate of subject species	(1) Marine mammals (2) Target commercial fish species (3) Incidental catch of non-specified species (4) Forage species (5) Prohibited species bycatch (6) ESA list Pacific salmon (7) Seabirds
Current size and quality of marine benthic habitat and other essential fish habitat	Marine benthic habitat and other essential fish habitat
Application of principles of ecosystem management	Ecosystem
Current management and enforcement activities	(1) State of Alaska managed fisheries (2) Management complexity and enforcement
Current rates of fishing accidents	Human safety and private property (vessels)

4.1 Effects on Marine Mammals

The Draft Programmatic SEIS (NMFS 2001a) examined effects of groundfish fishery management alternatives by focusing analyses around four core questions, modified from Lowry (1982):

1. Is the alternative management regime consistent with efforts to avoid direct interactions with marine mammals (incidental take and entanglement in marine debris)?
2. Does the alternative management regime result in fisheries harvests on prey species of particular importance to marine mammals, at levels that could compromise foraging success (harvest of prey species)?
3. Does the alternative management regime result in temporal or spatial concentration of fishing effort in areas used for foraging by marine mammals (spatial and temporal concentration of removals with some likelihood of localized depletion)?
4. Does the alternative management regime modify marine mammal or forage behavior to the extent that population level impacts could occur (disturbance)?

Those four questions, and the associated rating criteria established (Tables 4.1-1 and 4.1-7), were modified for use in this analysis from the process used in the Draft Programmatic SEIS (NMFS 2001a). The main departure from how they were used in the Draft Programmatic SEIS analysis was it evaluated alternatives with respect to consistency with a policy of marine mammal protection, whereas, in this analysis each suite of specific fishery management measures is evaluated independently against a criteria for significance established for each of the four above questions. Additionally two management tools used in the Draft Programmatic SEIS are not relevant to discussions of effects on marine mammal populations: vessel monitoring requirements and experimental design. As the experimental designs being proposed are directed at gaining answers to questions about Steller sea lions, however, discussion was added (Section 4.1.1.6) evaluating the potential each alternative has for experiments designed to monitor Steller sea lion population recovery in response to the fishery management measures being manipulated, or to evaluate the localized effects of commercial fishing on Steller sea lions.

In cases where absolute quantitative criteria for significance could not be established, the fishery management measures in effect in 1998 were used as a benchmark upon which to compare these five alternatives with respect to effects on marine mammals, as expressed by the above questions. That is, once it was determined how much of an effect could be expected, as delineated by the above questions, other alternatives were evaluated relative to the performance of the 1998 benchmark.

This analysis is comprised of three tiers:

- a. The effects on each of seven marine mammal species or species groups are discussed separately (Steller sea lions, ESA listed great whales, other cetaceans, northern fur seals, harbor seals, other pinnipeds, sea otters).
- b. Each alternative is addressed for each species or species group.
- c. Each question (type of effect) is addressed for each alternative within each species or species group.

4.1.1 Effects on Steller Sea Lions

Direct and indirect interactions between Steller sea lions and groundfish fisheries occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important sea lion prey, and due to temporal and spatial overlap in sea lion foraging and commercial fishing activities. Of the groundfish species targeted for harvest, pollock, Atka mackerel, and Pacific cod rank foremost among important sea lion diet items (Sinclair and Zeppelin, submitted) and similar sizes are targeted by sea lions and fisheries. Thus subsequent analyses focus on effects of fisheries targeting those species. A metric was established (Table 4.1-6) for Steller sea lions to assess intensity of effects (harvest of prey species and spatial/temporal concentration, Question 3) and associated percent increase to populations, and new population trends for Steller sea lions. Significance ratings for each question are summarized in Table 4.1-6.

Evaluation of the effects of fisheries removals of groundfish on Steller sea lions require models that ultimately could relate fish biomass removed directly to changes in sea lion fecundity and survival. Such a model would do so across a broad range of temporal and spatial scales, incorporate potential changes in climate (Benson and Trites, 2000), and such a model does not currently exist. Several models have been developed to test hypotheses about the Bering Sea ecosystem and factors underlying past changes in Steller sea lion abundance (Pascual and Adkison, 1994; Trites *et al.*, 1999; Shima *et al.*, 2000), but these models are general in scope, generally not predictive, and those that could be predictive are limited because the degree of correspondence with the actual ecosystem is unknown (Trites *et al.*, 1999). Other models, such as used by Livingston (2001) model multi-species interactions, but incorporate marine mammal abundance

as an input rather than predictive output. One attempt at moving from global availability of groundfish to smaller spatial scales was the development of a forage-ratio model to determine whether the harvest under Alternative 4 would result in adverse modification of Steller sea lion critical habitat (Biological Opinion, Appendix A of this SEIS). This model required a number of assumptions, and was deemed to be most appropriate for large spatial scales. Analysis of finer spatial scales was performed qualitatively.

In the absence of models relating standing fish biomass to sea lion fecundity and survival, the effect on Steller sea lions by the harvest of prey species (Question 2) was analyzed in the draft of this analysis by examining differences among the Alternatives of TAC on broad geographic scales. Comments received from the NPFMC Scientific Statistical Committee (SSC) suggested that such an emphasis on global TAC was inconsistent with previous analyses suggesting global fishing removal levels did not constrain sea lions (NMFS, 2000a). To date, causal links have not been scientifically demonstrated between fishery harvests and marine mammal abundance (Northridge and Hofman, 1999; Bowen *et al.*, 2001). In and of itself, TAC gives no indication of standing biomass remaining after fishing, and also requires an assumption that the benefits of unharvested biomass would benefit sea lions. We considered using exploitation rate, and the difference in estimated exploitable biomass and removals (what's left after fishing), as the metric for judging effects under Question 2. The problem with this approach is that the remaining standing biomass after fishing, in the same area where fishing and foraging co-occur, is unknown. Likewise, the difference in total estimated biomass when TAC is removed for each Alternative is relatively small, overall, and because this difference is so small the possible effect of the Alternatives on the marine mammal species in question could not be gauged. Also note that TAC for these fisheries is set under a process separate (which includes a separate NEPA analysis) than covered in this SEIS. However, it seems appropriate to evaluate any TAC differences that may exist among the Alternatives with respect to mitigation of impacts on Steller sea lions, and for potential impacts to other marine mammal species.

In response to comments, we used an analysis of daily removals for each alternative and a comparison of deviations from the mean daily removals calculated for all alternatives combined (see explanation under 4.1.1 and 4.1.1.1). These "deviation differences" were essentially the proportional residual of an Alternative's estimated daily removal from the average of all Alternatives removals for that day. Thus the "deviation differences" were independent of global TAC, yet would yield lower values if a particular Alternative had daily removal rates lower than the grand mean. This index, however, was overly sensitive to Alternatives that fished during periods closed under other Alternatives, regardless of the magnitude of removals. In addition, comments from the NPFMC SSC indicated the index was neither straightforward nor intuitive in its use (Scientific Statistical Committee, 2001). The SSC suggested an additional analysis based on the root mean square error (RMSE) of the daily removal rates, which is sensitive to TAC and variation in the estimated daily catch rates (SSC, 2001). Such an analysis (described in detail in 4.1.1 and 4.1.1.1) was added for this final SEIS. This index, however, does not distinguish among removals that may be generally lower than the combined daily average. Comparison of differences in actual TAC levels was incorporated into the overall judgement of effects by the analyst, but was a tertiary consideration in the evaluation. In the absence of models relating fish biomass to changes in sea lion survival or fecundity, the TAC, deviation difference, and RMSE analyses provide a quantitative means to compare the alternatives. Because sea lions and fisheries are dependent upon aggregations of prey species, changes in the standing biomass (and therefore overall TAC) may be less important to sea lions than local spatial and temporal removal patterns. Those effects were evaluated under Question 3.

All of these models assumed the following:

1. Low TAC is better for Steller sea lions,
2. A constant catch throughout the year is better,
3. There is a TAC that would have significantly positive effects to Steller sea lions compared to those presented in the Alternatives, and
4. There is a relationship (currently unquantified) between spatial and temporal concentrations of harvest and fecundity and survival of Steller sea lions.

An assumption that lower TAC would benefit sea lions is not as straightforward a conclusion as it should seem. Bioenergetic models suggest that on a gross scale the biomass remaining after fishing at current TAC's should be sufficient for sea lions, but those surplus fish may not benefit sea lions if distributed in such a way as to be unavailable for foraging (Winship, 2000). A multispecies model incorporating climate change with the effects of fishing on groundfish stocks suggested that no-fishing produced a smaller pollock spawning stock biomass than at $F_{40\%}$ and $F_{50\%}$ harvest rates (Livingston, 2001). Likewise, assuming that a constant catch throughout the year would benefit sea lions by minimizing spikes of removals and maintaining a higher standing biomass can be contrasted with findings of the Draft Programmatic SEIS (NMFS, 2001a), which found "short-burst" fishing beneficial so long as pulses occurred outside of critical life history periods. The timing of such pulses among these Alternatives is evaluated in Question 3 (spatial/temporal aspects). The notion of a TAC giving significantly positive benefits to sea lions relative to a reference point depends upon the reference used for comparison, such as no fishing, a mean of all Alternative TAC's (essentially the basis for the "deviation difference" analysis), or some other TAC. For the RMSE analysis we based an (S+) TAC on the Fowler and Perez (1999) model examining the range of variation observed for pollock consumption by predators in the Eastern Bering Sea ecosystem. As in the Draft Programmatic SEIS, (NMFS 2001a), we chose 1.6% of standing biomass as being a target harvest rate within the range of observed natural variation. This rate was applied to all groundfish stocks under consideration, and standing biomasses were taken from the 2000 stock assessment and fishery evaluation reports (NPFMC, 2000c; 2000d).

4.1.1.1 Effects of Alternative 1 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The estimated mean annual mortality from the 1995-1999 groundfish fisheries is 8.4 sea lions (Angliss *et al.*, 2001). Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)¹. The estimated annual incidental take level of Steller sea lions under Alternative 1 in all areas combined is 13 Steller sea lions (with a confidence interval [CI] = 10 - 16 Steller sea lions; Table 4.1-2). Incidental bycatch frequencies, which are typically low, are summarized in Figure 4.1-4; they also reflect locations where fishing effort was highest. In the Aleutian Islands and GOA, incidental takes are often within critical habitat, though in the Bering Sea such bycatch is farther off shore and along the continental shelf. Otherwise there seems to be no apparent "hot spot" of incidental catch disproportionate with fishing effort. It is, therefore, appropriate to estimate catch ratios based on estimated TAC. Noting, however, that if these take rates differ between observed and unobserved vessels then these take estimates would be biased accordingly. These rates also reflect a

¹Dan Ito, "Personal Communication," National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115.

prohibition of trawling within 10 or 20 nm of 37 rookeries which likely reduces the potential for incidental take, particularly during the breeding season when females are on feeding trips within the critical habitat area. For Alternative 1, it is likely that the same amount of fishing effort will occur, regardless of the number of seasons (two in this alternative).

Entanglement of Steller sea lions in derelict fishing gear or other materials seems to occur at frequencies that do not have significant effects upon the population. From a sample of rookeries and haul-out sites in the Aleutian Islands, of 15,957 adults observed, Loughlin *et al.* (1986) found only 11 (0.07%) entangled in marine debris, some of which was derelict fishing gear. Observations of sea lions at Marmot Island for several months during the same year observed 2 of 2,200 adults (0.09%) entangled in marine debris. During 1993-1997, only one fishery-related stranding was reported from the range of the western stock, a sea lion observed in August 1997 with troll gear in its mouth and down its throat (Angliss *et al.*, in press). Entanglement of sea lions in derelict fishing gear or other marine debris does not appear to represent a significant threat to the population. In conclusion, incidental take and entanglement in marine debris under Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

Daily average removal rates were calculated for each Alternative's proposed fishing seasons by dividing the allocated TAC for a season by the duration of that season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). If an Alternative proposed a daily catch limit lower than this daily average, then the value of the limit was used. Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 1, approximately 7,500 mt/day of pollock and cod are projected to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate from the average for all Alternatives on February 1 is about +0.4, suggesting that, compared to the other four Alternatives, more pollock and cod in the EBS will be removed on that day under Alternative 1 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6, -8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 1, the deviation difference for pollock in the Bering Sea and the Aleutian Islands resulted in negative values (less fish removed) and positive values for the Gulf of Alaska (more fish removed). These values were subjectively appraised by the analyst as insignificant (-100 to +100) for pollock in the eastern Bering Sea and Aleutian Islands and Pacific cod in all areas (with cod removals in the Aleutian islands slightly into the CS- category. A CS- (+101 to +250) judgement was assigned to central Aleutian Island mackerel and Gulf of Alaska pollock. Pacific cod deviation differences varied by area but were all relatively small values except for a large positive value for Aleutian Islands cod, and Atka mackerel were both negative and positive. Overall, Alternative 1 had a -15 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -15, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in a bimodal peak of average removal rates during February through April, and September to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 1 has relatively lower average daily removal rates during the late spring and summer, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). Similar patterns are seen in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8). In the GOA projected average daily removal rates of pollock and cod are highest in mid summer (Figure 4.1-9 and 4.1-10). The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 1 is 1,831,297 mt (Table 4.1-4). TAC removals at those levels for pollock and Pacific cod, in concert with time and space considerations, were thought to be having a negative effects on Steller sea lions (NMFS 1998b).

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1+} - m)^2 / 365}$$

Alternative 1 had the highest RMSE value among all Alternatives (Table 4.1-5), mainly due to the large variance in daily catch rates (Figures 4.1-5 to 4.1-10) of all target species, rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take other target fish and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of these species removed under Alternative 1 is estimated to be less than 3% of the total catch in the Gulf of Alaska, and much lower than 3% of the total catch in the Bering Sea (NMFS unpublished observer program data)². The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS- resulted in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Applicable to all fisheries, Alternative 1 contains closures within 10 nm of 37 rookeries to all trawling year-round, with some extending to 20 nm on a seasonal basis. Specifically, Alternative 1 contains the following:

The walleye pollock fishery in the BSAI has two seasons, January 20-April 15 (45% of TAC) and September 1-November 1 (55% of TAC). There are eastern BS and AI area apportionments of the TAC. GOA TAC is split into three seasons and the TAC is split 25%, 35%, and 45%, accordingly. Pollock trawling is closed in the CVOA June 10-December 31. The Pacific cod BSAI fishery is apportioned into three seasons and two gear types (trawl – January 20-December 31; and fixed – January 1 - December 31 in three seasons). The Pacific cod TAC is set BSAI-wide. In the GOA, fixed gear opens January 1 and trawl January 20; fishing occurs until the end of the year for both. The Atka mackerel fishery is in two seasons, January to April 15, and September 1 to November 1 with 50% of the TAC apportioned in each season. Atka mackerel harvest is limited to 40% of TAC inside Steller sea lion critical habitat. Compared to a temporally even removal

²Ibid.

rate, Alternative 1 had the greatest degree of variability of all Alternatives based on RMSE analysis (Table 4.1-5).

Sinclair and Zeppelin (submitted) showed that regions based on diet similarity closely paralleled the metapopulation clusters defined by York *et al.* (1996), in that Sinclair and Zeppelin's region 1 represents the eastern and central Gulf of Alaska as defined by York *et al.* (1996). Region 2 represents the western GOA in the York *et al.* (1996) scheme, region 3 represents the eastern Aleutian Islands, and region 4 the central and western Aleutian Islands. Because these two analyses result in similar clustering, population projections relevant to York *et al.* (1996) using those regions/areas (e.g., Figure 3.1-9) can be used in the context of comparing diet differences, fisheries allocations, and population trajectories. For this reason, the present analysis was based on Steller sea lion metapopulations rather than on the 13 monitoring areas proposed in NMFS (2000a) *per se*.

In addition, Loughlin and York (2001) provided an accounting of losses to the Steller sea lion population stratified by metapopulation areas using sources of known mortality, including subsistence harvest, incidental take in fisheries, illegal shooting, research, and predation by killer whales and sharks. Some portion of the remaining unknown mortality from the Loughlin and York (2001) study may be attributable to removal of prey by commercial fisheries. For example, in 2001, losses from a stable population would have been 4,710, with and additional 1,715 losses accounting for the decline. This totals 6,425 sea lions lost to the population. Of the 1,715 losses, 55%-75% could not be attributed to a specific cause. The following discussion incorporates analyses from Sinclair and Zeppelin (submitted), York *et al.* (1996), and Loughlin and York (2001) to assess the effect of the five alternatives on these losses that were not attributable to a specific source.

Effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging. Benefits to sea lions are likely linked to the extent that an alternative reduces removals of key prey species within sea lion foraging areas, and during critical time periods such as April-June, when energy requirements of late-term pregnant females are greatest and pups from the prior year may begin weaning, and May-August, when females are tied to rookeries while nursing pups.

The proportion of pollock, Pacific cod, and Atka mackerel in the Steller sea lion diet varies by area and season (Figure 4.1-11, Figure 4.1-12). A recent study that examined sea lion scat (Sinclair and Zeppelin, submitted) showed that sea lion diet can be classified into four sea lion regional clusters (Figure 3.1-9). In region 1 (Prince William Sound to the Semidi Islands) pollock comprised 64% of the frequency of occurrence (FO) in summer (May-September) and 56% FO in winter (December-April) of the Steller sea lions diet. For region 2 (Shumagin Islands to the Sanak Islands) pollock comprised 80% FO in summer and 86% FO in winter. In region 3, (Sanak Islands to Ogchul Island) pollock comprised 54% FO in summer and 59% FO in winter. And in region 4 (all islands west of Umnak Island), pollock comprised 10% FO in summer and 3% FO in winter. Sinclair and Zeppelin (submitted) found that Pacific cod in region 1 during summer was 5% FO in summer and 31% FO in winter. In region 2, Pacific cod was 11% FO in summer and 36% FO in winter. For region 3, cod was 6% FO in summer and 20% FO in winter, and for region 4, cod was 7% FO in summer and 17% FO in winter. For Atka mackerel, Sinclair and Zeppelin (submitted), found no occurrence in summer and 2% FO in winter in region 1. For region 2, Atka mackerel occurrence was 2% FO in summer and 4% FO in winter; region 3 had 26% FO in summer and 25% FO in winter. And for region 4, Atka mackerel was 93% FO in summer and 65% FO in winter.

Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 1 will not result in a stable population (Table 4.1-6). Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-6). Overall, the effects of Alternative 1 are conditionally significant negative (Table 4.1-7) according to the criteria set for significance in Table 4.1-1.

Indirect Effects - Disturbance Effects (Question 4)

This and all other alternatives contain measures that avoid important forms of disturbance to Steller sea lions at rookeries during the breeding season. In particular, the prohibition of vessel entry within 3 nm of 37 rookeries avoids intentional and unintentional disturbance of hauled-out sea lions, including new born pups, or those animals aggregated near shore. More than 3,250 km² around 37 sites is offered for protection under this alternative.

Vessel traffic, nets moving through the water column, or underwater sound production may all represent perturbations, which could affect foraging behavior, but few data exist to determine their relevance to Steller sea lions. We note especially, that the influence of trawl activities on Steller sea lion foraging success cannot be addressed directly with existing data. Foraging could potentially be affected not only by interactions between vessel and sea lion, but also by changes in fish schooling behavior, distributions, or densities in response to harvesting activities. In other words, disturbance to the prey base may be as relevant a consideration as disturbance to the predator itself.

For the purposes of this analysis, we recognize that some level of prey disturbance may occur as a fisheries effect. The impact on marine mammals using those schools for prey is a function of both the amount of fishing activity and its concentration in space and time, neither of which may be extreme enough under Alternative 1 to represent population level concerns. To the extent that fishery management measures under Alternative 1 do impose limits on fishing activities inside critical habitat, we assume at least some protection is provided from these disturbance effects. These protections occur as byproducts of other actions which either reduce fishing effort or create buffer zones to limit impacts on foraging. Also, they occur directly in the case of the 3-nm, no-entry zones around rookeries. Whether the residual levels of disturbance represent significant effects on Steller sea lions can not be determined from data currently available.

Anecdotal evidence, however, suggests that fisheries-related disturbance events are unlikely to be of consequence to the Steller sea lion population as a whole. For instance, vessel traffic and underwater sound production have long been features of the Bering Sea and Gulf of Alaska, at least over much of the twentieth century. Such circumstances have prevailed before, as well as after, the decline of Steller sea lions, suggesting no obvious causal link. Steller sea lions also appear to be tolerant of at least some anthropogenic effects, as noted by their attraction to fish processing facilities and gillnets, as well as their distributions in proximity to ports. Further, the eastern stock of Steller sea lions is increasing, despite anthropogenic activities throughout their range on the west coast of North America and particularly in southeast Alaska. Overall, these circumstances suggest that disturbance effects are likely to be insignificant to Steller sea lions at the population response level. Thus, the effect of Alternative 1 is insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.2 Effects of Alternative 2 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 2 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)³. Takes of Steller sea lions currently are rare events in all Alaska groundfish fisheries, with no apparent pattern to their temporal or spatial distribution (Figure 4.1-4). For example, the total number of animals killed is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this Alternative, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

Under Alternative 2, TACs for pollock, Pacific cod, and Atka mackerel are reduced; thus, proportional reductions in incidental take could be expected. However, the apportionment of the TAC reductions did not result in the reduction of the expected incidental catch of Steller sea lions (Table 4.1-2). Similarly, reduced fishing activity inside critical habitat, where Steller sea lions may be expected to spend a greater percentage of their foraging and transit time, could further lower incidental take. The overall effect of any such reductions on population trends, however, would be indistinguishable.

With respect to entanglement in marine debris, Alternative 2 does not alter the effects described under Alternative 1. That is, the effect is insignificant. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 2 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.1 daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 2, approximately 6,000 mt/day of pollock and cod were estimated to be harvested on February 1. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 2 is about zero, suggesting that, compared to the other four Alternatives, the same amount of pollock and cod in the EBS will be removed on that day under Alternative 2 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6, -8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

³Ibid.

For Alternative 2, the deviation difference for pollock in the Bering Sea resulted in +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in quarterly peaks of average removal rates during February/March, April/June, July/August, and September/December (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 2 has relatively equal average daily removal rates during most season except winter when the rates are the highest of any Alternative, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). Different patterns are seen in the Aleutian Islands and Gulf of Alaska (Figure 4.1-7, -9 and Figures 4.1-8, -10) where the removal rates tend to be less than the mean daily removal rates.

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 2 is 1,646,297 mt (Table 4.1-4). The amount of the fishery removals of all key prey species is reduced by 10%. Reduced competitive effects, in turn, should avoid impacts on fitness or population recovery. Alternative 2 dampens the effects of harvest of the key prey species with different combinations of management measures, and includes reductions in TACs.

Reductions in TAC range from a low of 2% for eastern Bering Sea pollock to a high of 92% for Aleutian Islands pollock. Some of these reductions may be more important to Steller sea lions than others. For example, while a 92% reduction in Aleutian Islands pollock TAC is a large difference, diet studies indicate that pollock become less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). In addition to lowering TAC, spatial and temporal restrictions are discussed below.

Groundfish fisheries incidentally take some non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The bycatch of these species under Alternative 2, however, is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)⁴.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1\sigma} - m)^2 / 365}$$

⁴Ibid.

Alternative 2 had the lowest RMSE values among all Alternatives (Table 4.1-5), due to TAC reductions and temporal evenness of removals. There was little difference in RMSE among Alternative's 2-5 for the Eastern Bering Sea pollock fishery, and overall RMSE's were similar for Alternatives 2, 4, and 5 (Table 4.1-5).

Thus, Alternative 2 provides greater protection from effects of harvesting Steller sea lion prey species than Alternative 1. Further, the reductions in TACs are substantial enough (i.e., more than 20%, for two key species) to rank them as conditionally significant positive according to the significance criteria established in Table 4.1-1. The combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE scores, and the TAC ranking of CS+, resulted in the assignment of an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Alternative 2 establishes lower total allowable catch levels (for pollock, Pacific cod, and Atka mackerel), prohibits trawling in critical habitat, and implements measures to spread out catches through the year. Applicable to all fisheries is no trawling for any groundfish species within Steller sea lion critical habitat. Relevant measures to the analysis include:

- Four seasons would be established for pollock, Pacific cod, and Atka mackerel fisheries with equal seasonal TAC apportionment: January 20 - March 15 (25%), April 1 - June 1 (25%), June 15 - August 15 (25%), September 1 - Dec 31 (25%). Two week stand-downs would be established between seasons with no rollover of TAC allowed.

Applicable to pollock fisheries:

- The Aleutian Islands would be closed to directed pollock fishing.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS pollock TAC, 74.5% of ABC; GOA pollock TAC, 44.8% of ABC.
- Separate TACs would be established for Bering Sea pollock east and west of 170° W longitude, and GOA pollock TACS would be established by management area (e.g., 610, 620, 630) and for Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the pollock fisheries as follows: BS pollock, 5,000 mt; GOA pollock, 1,000 mt.

Applicable to the Pacific cod fisheries:

- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.
- Maximum TACs would be established as a percentage of the maximum ABC as follows: BS cod TAC, 71.8% of ABC; AI cod TAC, 71.8% of ABC; GOA cod TAC, 55.0% of ABC.
- Separate TACs would be established for Bering Sea cod east and west of 170° W longitude, separate AI cod TACs would be established by management area (e.g., 541, 542, 543); and GOA cod TACS would be established by management area (e.g., 610, 620, 630) and for the Shelikof Strait.
- Maximum daily catch limits would be established for the fleet of vessels fishing in the cod fisheries as follows: BS cod, 600 mt; AI cod, 600 mt; GOA cod, 400 mt.
- Foraging area (Seguam, SCA, Shelikof) catch limits would be established at 10% of survey biomass estimate.
- A zonal approach would be implemented for BSAI and GOA Pacific cod fisheries.

Applicable to Atka mackerel fisheries:

- Maximum mackerel TAC would be established at 33% of the maximum ABC.
- Separate TACs would be established for AI management areas (e.g., 541, 542, 543).
- A maximum daily catch limit of 300 mt would be established for the fleet of vessels fishing in the mackerel fishery.

As with Alternative 1, question 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

For the central and eastern GOA metapopulation, a 55% reduction in pollock TAC and 38% reduction in cod TAC would likely benefit sea lion population trends, particularly during the winter when cod is more common in the diet. Closures of critical habitat to trawling could potentially provide a large degree of separation between fisheries removal and foraging which will also benefit sea lions. The same could be said for other metapopulations where the magnitude of TAC reduction is similar. Likewise, the spreading of allowable catch across four seasons with daily catch limits may reduce the likelihood of regional prey competition. However, determining the magnitude of the effect for this alternative on sea lion metapopulations in general is not possible, except that in most cases it is likely to be positive. The fine resolution of management suggested in this alternative exceeds the resolution available on Steller sea lions; thus the effects of Alternative 2 at the metapopulation level, or at finer scales, cannot be determined.

Daily average removal rates were calculated by dividing the allocated TAC by length of season, and summing, as appropriate, for open pollock, Pacific cod, or Atka mackerel fisheries. Actual daily fisheries removal rates may be higher or lower than this value. Projected average daily removal rates of pollock and cod in the Eastern Bering Sea are comparable in magnitude to the other alternatives (Figure 4.1-5, Figure 4.1-6), though with brief closures separating the fishing periods. Curiously, the pollock TAC allocated to the Eastern Bering Sea could not practically be removed because of daily catch limits. Under the management regime of Alternative 2, four seasons of 54 days (Season A), 61 days (B, C), and 121 days (D) were allocated 343,073 mt each, with no TAC rollover allowed between seasons (see Section 2.3.2). Average daily removal rates within each season to meet this TAC are 6353 mt, 5624 mt, 5624 mt and 2835 mt for the A through D seasons, respectively. However, Alternative 2 caps daily pollock removals from the Eastern Bering Sea at 5000 mt per day (Section 2.3.2), so without TAC rollover about 2601 mt would be forgone. This may have been an unintended consequence, because daily limits in the Gulf of Alaska and Aleutian Islands do not seem to result in "lost" TAC. The overall TAC of pollock and Pacific Cod in the Eastern Bering Sea is only reduced by 2% and 18%, respectively (Table 4.1-3). However, the percentage splits in allowed removals east and west of 170° W longitude of 52/48 (A season), 45/55 (B season), and 39/61 C and D seasons), combined with the daily catch limit of 1000 mt/d and no trawling within critical habitat should greatly reconfigure removals from east of 170° W, where most of the pollock were harvested during 1998-2000 (Figure 4.1-15). A similar split is made in pollock and Pacific cod allocations between western and central Gulf of Alaska TACs (see Section 2.3.2). Given the relatively large contribution of pollock in the summer and winter diets of sea lions in the Eastern Aleutian Islands (Figure 3.1-9, Figure 4.1-11, Figure 4.1-12), this could be beneficial to sea lions. Given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread such a benefit could be to the sea lion population in general. Within the western stock of Steller sea lions, the Eastern Aleutian Island metapopulation has exhibited the lowest annual decline rate (-1.75% during 1991-2000) (Loughlin and York 2001).

Because of reduced pollock, Pacific cod, and Atka mackerel TACs in the Gulf of Alaska and Aleutian Islands, average daily removal rates are lower than in the other alternatives (Figure 4.1-7, Figure 4.1-8, Figure 4.1-9, Figure 4.1-10). Also in contrast to other alternatives, Alternative 2 prevents greater removal rates during critical periods of April-June (late pregnancy and beginning of pup weaning) and May-July (pup lactation period on rookeries). Of all the alternatives, Alternative 2 measures appear to result in the least temporal concentration of fishery removals of key sea lion prey species.

Alternative 2 management measures result in much less spatial and temporal concentration of fisheries removals of key Steller sea lion prey species than do measures under other alternatives, and hence rates a conditionally significant positive using the criteria established for significance (Table 4.1-1). The overall TAC, however, is only 10% less than the other alternatives (Table 4.1-4), and thus the overall effect on the population may not be as intense. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 2 will not result in a stable population, changes to the sea lion population would be within 4% of the current trend, and an overall decline would continue at -1.4% to -2.3% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, to the extent that Alternative 2 reduces fishing activities inside critical habitat and at haul-out sites, the former by extending closed areas and the latter by a reduction in TACs for pollock, Pacific cod, and Atka mackerel, potential disturbance effects may be further reduced or avoided. Thus, the scale of change in fishing activity imposed under Alternative 2 would result in less disturbance. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.1.3 The effects of Alternative 3 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 3 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)⁵. Takes of Steller sea lions currently are rare events in all of the Alaskan groundfish fisheries, with no apparent pattern to their temporal or spatial distribution. For example, the total numbers of incidental take is expected to be less than 14 (CI = 11-17) based on allocations of TAC in Alternative 3, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 3 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects

⁵Ibid.

are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 3 is rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.1, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 3, approximately 4,300 mt/day of pollock and cod were estimated to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 3 is about -0.2, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 3 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6, -8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 3, the deviation difference for pollock in the Bering Sea resulted in -36 (I), but high variability occurred by area with the Aleutian Islands ranking as S-, and all other areas as CS-. Pacific cod removals overall ranked as CS+ in the Aleutian Islands and insignificant elsewhere. Atka mackerel removals under Alternative 3 all resulted in positive values with a CS- ranking for the EBSAI area and insignificant for other areas (Table 4.1-3). Overall, Alternative 3 had a -49 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 3 has relatively equal average daily removal rates during most season, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6).

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 3 is 1,813,830 mt (Table 4.1-4). Alternative 3 contains a "global control rule" that adjusts TAC relative to surveyed spawning biomass. However, the projected TAC does not differ substantially from that of Alternative 1 (or for that matter Alternatives 4 and 5; Table 4.1-4). The largest (and only) reduction is in GOA pollock which is 18% less than the TAC established in Alternative 1.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily

catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{i*} - \bar{m})^2 / 365}$$

Alternative 3 had the second highest RMSE value among all Alternatives (Table 4.1-5), mainly due to the large variance in daily catch rates (Figures 4.1-5 to 4.1-10) of Aleutian Island pollock and Gulf of Alaska Pacific cod, rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 3 is estimated to be less than 4% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data)⁶.

Alternative 3 contains additional management measures beyond those used under Alternative 1 to manage the harvest within critical habitat. Because GOA TAC is reduced between 5% and 20%, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated insignificant (Table 4.1-7). The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS-, therefore the analyst assigned an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Essential spatial and temporal elements of this approach are to establish large areas of critical habitat where fishing for pollock, Pacific cod, and Atka mackerel is prohibited, and to restrict catch levels in remaining critical habitat areas. Details are as follows:

Applicable to all pollock, Pacific cod and Atka mackerel fisheries:

- Closure areas to directed fishing for pollock, Pacific cod, and Atka mackerel inside specified sites.
- Trawl fishing for pollock, Pacific cod and Atka mackerel prohibited November 1 January 20.
- Fishing for pollock, Pacific cod and Atka mackerel prohibited from November 1 through January 20 inside critical habitat.
- Outside of critical habitat, two evenly spaced seasons for pollock, Pacific cod, and Atka mackerel fisheries in the EBS, GOA, and AI.

Applicable to pollock fisheries:

- A portion of the Aleutian Islands would be open to pollock fishing (Area 12)

Applicable to the Pacific cod fisheries:

- The Pacific cod TAC would be split from a combined BSAI TAC to separate TACs for the EBS and the AI based on the biomass distribution of the stock.

As with Alternatives 1 and 2, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and

⁶Ibid.

location of fisheries removals relative to the importance of the target species in Steller sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Alternative 3 reduces spatial concentration by creating large closures within three broad areas, prohibiting fishing within critical habitat during November 1 through January 20, and creates four rather than two seasons within critical habitat which along with catch limits reduce spatial concentration of fisheries removals. Overall average daily removal rates for Eastern Bering Sea pollock and Pacific cod are fairly evenly distributed throughout the year (Figure 4.1-5, Figure 4.1-6). Likewise, Aleutian Island pollock, Atka mackerel and Pacific cod estimated average daily removal rates are even throughout the year (Figure 4.1-7), though relative to removals of all other alternatives is relatively greater during June through September (Figure 4.1-8), a critical period for Steller sea lion lactation. Similarly, GOA Pacific cod and pollock have relatively greater estimated average daily removal rates and similar TAC allocations compared to other alternatives during June through September, though there are removal limits within critical habitat.

Alternative 3 generally spreads fish removals over time and seasons, and thus results in marginally less spatial and temporal concentration of fisheries removals than Alternative 1, and hence rates as insignificant using the criteria established for significance (Table 4.1-1). The overall TAC, however, is similar to all other Alternatives except Alternative 2, which may reduce the benefit to Steller sea lions. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 3 will not result in a stable population. Thus, changes to the Steller sea lion population would be within 2% of the current trend, and an overall decline would likely continue at -1.4% to -5.2% per year (Table 4.1-6). Overall, using the criteria for determining significance in Table 4.1-1 the effect on Steller sea lion populations under Alternative 3 is rated conditionally significant positive (Table 4.1-7).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 3 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a minor reduction in TACs of less than 1% for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 3 results in marginally less disturbance. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.4 The effects of Alternative 4 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for each fishery area (NMFS, unpublished observer program data)⁷. The total amount of incidental take under Alternative 4 is expected to be less than 13 (as in Alternative 1) based on allocations of TAC in this

⁷Ibid.

Alternative, or about one sea lion per 140,000 mt of groundfish harvested. The level of incidental take in either the BSAI or the GOA has not increased over the past decade.

With respect to entanglement in marine debris, Alternative 4 does not alter the effects described under Alternative 1. That is, there is no significant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated as insignificant under the criteria established for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.2, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 4, approximately 4,700 mt/day of pollock and were projected to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 4 is about -0.1, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 4 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6, -8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 4, the deviation difference for pollock in the Bering Sea resulted in -29 (CS+), but high variability occurred by area with the Aleutian Islands ranking as S- with a value of +470, and all other areas as CS-. Pacific cod removals overall ranked as S- in the Aleutian Islands and CS- elsewhere. Atka mackerel removals under Alternative 4 all resulted in negative values with a CS+ ranking (Table 4.1-3). Overall, Alternative 4 had a +58 value, suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +58, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 4 has relatively equal average daily removal rates during most seasons, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6). The exception is the high removal of cod during winter when such fishing is not proposed in the other Alternatives.

The combined TAC of pollock, Pacific cod, and Atka mackerel under Alternative 4 is 1,831,299 mt, virtually the same as Alternatives 1, 3, and 5 (Table 4.1-4). Estimated TACs region-wide are the same as under Alternative 1. Alternative 4 contains additional seasonal and gear apportionments to distribute catch relative to Alternative 1.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{i+} - m)^2 / 365}$$

Alternative 4 had an overall RMSE value similar to Alternatives 2, and 5, and an Eastern Bering Sea pollock RMSE similar to Alternatives 2-5 (Table 4.1-5). Alternative 4 had the highest RMSE value for BSAI Pacific cod due to greater variability in daily harvest rates (Figures 4.1-5 to 4.1-8), rather than to differences in TAC (Table 4.1-4).

Groundfish fisheries also incidentally take non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). However, the bycatch of these species under Alternative 4 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)⁹.

Because the TAC is identical to that of Alternative 1, no additional benefits to Steller sea lions accrue. Therefore, this alternative is rated conditionally significant negative (Table 4.1-7) for TAC according to the criteria established for determining significance in Table 4.1-1. The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE values, and the TAC ranking of CS-, resulted in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

This approach allows for different types of management measures in the three areas (AI, BS, and GOA). Essential measures include fishery specific closed areas around rookeries and haul-out sites, together with seasons and catch apportionments. Specific measures are complex and will not be repeated here, they are fully discussed in Section 2.3.4 Alternative 4.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and Steller sea lion foraging.

Two Eastern Bering Sea pollock and Pacific cod seasons provide fairly uniform estimated average daily removal rates throughout the year, though slightly increased during July-November due to a larger TAC apportionment (Figure 4.1-5, Figure 4.1-6). Temporal distribution of average daily removals is similar to Alternatives 3 and 5. In contrast, combined estimated average daily removal rates of Atka mackerel, pollock, and Pacific cod were the largest of all Alternatives in the Aleutian Islands (Figure 4.1-7, Figure 4.1-8), and particularly greater during the critical spring period (Figure 4.1-8). Gulf of Alaska removals are concentrated in four periods, though estimated removal rates are generally lower relative to other alternatives in spring and summer (Figure 4.1-9, Figure 4.1-10).

Alternative 4 also creates a series of area closures or removal limits to spatially spread fish removals. Management Areas 4 and 9 and the Seguam foraging area are closed to fishing for pollock, Pacific cod and Atka mackerel, and within 20 nm of five northern Bering Sea haul-outs (NMFS 2000 Biological Opinion). The closures of these areas is not likely be of great benefit to sea lions, however, as the amount of pollock (Figure 4.1-15) and Pacific cod (Figure 4.1-16) catch, and Atka mackerel effort (Figure 4.1-17) during 1998-2000 in these areas was minimal. Similarly, because pollock are not a key item in Steller sea lion diet west of 170°W longitude (Figure 4.1-11, Figure 4.1-12), prohibiting pollock fishing in the Aleutian Islands may have little benefit to sea lions. Closures to pollock fishing out to 10 or 20 nm around most rookeries and haul-outs in GOA management Areas 1, 2, 3, 4, 5, 6, 10 and 11 could be beneficial to sea lions given the importance of pollock in their diet in those areas (Figure 4.1-11, Figure 4.1-12), particularly during periods of pup rearing when mothers forage from the rookeries. The benefit of these closures outside of the pupping season becomes less clear, given seasonal movements of Steller sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Fisheries allocations are shifted by gear types, seasons, and areas, and represent improvements over Alternative 1 in some areas, the measures under Alternative 4 are rated as insignificant under the criteria established for significance (Table 4.1-1). Additionally, the overall amount of TAC removed is the same as all other alternatives except Alternatives 2 and 5. As with the other alternatives, given seasonal movements of Steller sea lions among areas, and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14), it is not possible to predict how widespread the effects of these measures are to the Steller sea lion population in general. Based upon Steller sea lion population trends during 1990-2000, it is assumed that Alternative 4 will not result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -7.1% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. However, Alternative 4 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haul-out sites. It also contains a variety of schemes to reduce fisheries impacts on Steller sea lions across the GOA and Aleutian Islands. However, the overall TAC is the same as in Alternative 1 for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 4 results in marginally less disturbance. Although the levels of protection from disturbance effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, Alternative 4 is rated insignificant according to the criteria set for significance (Table 4.1-1).

4.1.1.5 The Effects of Alternative 5 on Steller Sea Lions

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Annual levels of incidental mortality were estimated by multiplying the ratio of observed incidental take of dead animals to observed groundfish catch (stratified by area and gear type), to the new projected TAC for

each fishery area (NMFS, unpublished observer program data)⁸. The total amount of incidental take under Alternative 5 is expected to be less than 14 (CI = 11-17) Steller sea lions (as in Alternative 1) based on allocations of TAC under Alternative 5, or about one sea lion per 140,000 mt of groundfish harvested (Table 4.1-2). The level of incidental take in either the BSAI or the GOA has not increased over the past decade (Figure 4.1-4).

With respect to entanglement in marine debris, Alternative 5 does not alter the effects described under Alternative 1. That is, there is an insignificant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with; consequently, rated insignificant according to the criteria set for significance (Table 4.1-1).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

As defined in 4.1.1.2, daily average removal rates were calculated for the proposed fishing season by dividing the allocated TAC for that season by the duration of the season, and summing as appropriate for pollock, Pacific cod, or Atka mackerel fisheries (Figure 4.1-5). Actual daily fisheries removal rates may be higher or lower than this value. Deviations from relative mean daily removals for each Alternative were obtained by calculating the average removal rate for each day for all Alternatives (a "grand average"; the zero line in Figure 4.1-6) then dividing that value into the daily average removal rate for each Alternative. For example, Figures 4.1-5, -7, and -9 provide the daily average removal rates for each Alternative calculated by seasonal TAC. Under Alternative 5, approximately 4,500 mt/day of pollock and cod were estimated to be harvested on February 1 from the Eastern Bering Sea. In Figure 4.1-6, the deviation of this daily average removal rate on February 1 in Alternative 5 is about -0.2, suggesting that, compared to the other four Alternatives, less pollock and cod in the EBS will be removed on that day under Alternative 5 than with the other Alternatives. The effect of the Alternative was then judged based on the overall and seasonal daily average removals by summing the areas under the "curves" in Figures 4.1-6, -8, and -10 for the year resulting in a comparative value that we term the deviation difference (Table 4.1-3). Such values are used to distinguish the relative differences between the Alternatives; they are not additive nor can they be compared statistically. In this case, a positive value suggests more removals than the average and a negative value suggests less removals.

For Alternative 5, the deviation difference for pollock in the Bering Sea resulted in -40 (CS+), but high variability occurred by area with the Aleutian Islands ranking as S+, and all other areas as CS+. Pacific cod removals overall ranked as CS- in the Aleutian Islands, insignificant in the BSAI, and CS- elsewhere. Atka mackerel removals under Alternative 5 all resulted in negative values with insignificant rankings for all areas (Table 4.1-3). Overall, Alternative 5 had a -31 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar for all Alternatives.

The combined TAC of all groundfish in the Bering Sea results in relatively constant average removal rates from February through November with an increase of about 2,000 mt/day July to November (Figure 4.1-5). Compared to removals in the Bering Sea for all other alternatives, Alternative 3 has relatively equal average daily removal rates during most season, calculated as the deviation from the daily average removal rate averaged for all fisheries (Figure 4.1-6).

⁸Ibid.

The TAC of pollock, Pacific cod, and Atka mackerel under Alternative 5 is 1,809,497 mt, virtually the same as Alternatives 1, 3, and 4 (Table 4.1-4). The only reduction in TAC results from a prohibition on fishing for pollock in the Aleutian Islands, as in Alternative 2. The benefit to Steller sea lions from this reduction is equivocal. Diet studies indicate that pollock becomes less common in the diet of Steller sea lions in the Aleutian Islands than in the GOA and Bering Sea (Sinclair and Zeppelin, submitted). This alternative limits the amount of catch within critical habitat to be in proportion to estimated fish biomass.

A root mean square error (RMSE) index incorporating TAC and variability in the estimated daily catch rate was developed by comparing the average daily catch rate for the Alternative to a presumed (S+) rate based on a harvest of 1.6% of the standing biomass of the target species (see 4.1.1 for additional explanation). A daily catch rate (m) was estimated by dividing that TAC by 365 days for the species of interest, and a daily catch rate (dj) was calculated for the Alternative as above for the "deviation difference" analysis. The root mean square error (RMSE) was then calculated as:

$$RMSE = \sqrt{(S_{1+} - m)^2 / 365}$$

Alternative 5 had RMSE values similar to Alternatives 2-4 (Table 4.1-5), though was similar to Alternative 2 with the lowest RMSE values for Aleutian Islands pollock through TAC reduction ((Table 4.1-4).

Groundfish fisheries also incidentally take other target and non-target fish species, some of which are important Steller sea lion prey such as arrowtooth flounder, salmon, cephalopods, and herring (Sinclair and Zeppelin, submitted). The amount of bycatch of these species under Alternative 5 is estimated to be less than 4% of the total catch in the GOA, and much lower in the Bering Sea (NMFS unpublished observer program data)⁹.

Because TAC under Alternative 5 is within 5% of the Alternative 1 TAC, this alternative is rated as conditionally significant negative (Table 4.1-7) for TAC according to the criteria set for significance in Table 4.1-1. The combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, similar RMSE values, and the TAC ranking of CS-, resulted in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Features of this alternative applicable to pollock fisheries include:

- In the Bering Sea pollock fishery: four seasons with harvest limits within sea lion critical habitat foraging areas; and two seasons (40:60% allocation) outside critical habitat.
- In the GOA pollock fishery: fishery distributed over 4 seasons (30%, 15%, 30%, 25%).
- The Aleutian Islands area would be closed to pollock fishing.

Applicable to the Atka mackerel fisheries:

- Two seasons with TAC apportionments would be established: January 20 - April 15 (50%); September 1 - November 1 (50%).
- Harvest limits would be established in critical habitat: (40% inside critical habitat, and 60% outside)

⁹Ibid.

Applicable to the Pacific cod fisheries:

- In the BSAI cod fishery: separate TACs would be established for the Bering Sea and Aleutian Islands, two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) with harvest limits within critical habitat based on best estimates of biomass. Using these estimates, the Bering Sea TAC limits within CH are 20% in the A season and 3.6% in the B season. In the Aleutian Islands, the TAC limits within CH are 20% in the A season and 48.3% in the B season.
- In the GOA cod fishery: two seasons (A season Jan 20-April 30 at 40% of TAC; B season May 1-November 1 at 60% of TAC) would be established with harvest limits within critical habitat based on best estimates of biomass. Based on these estimates, the TAC limits within CH to start with are 20% in the A season and 31.8% in the B season.

As with Alternatives 1, 2, and 3, the effects of spatial and temporal distributions of fisheries catch on unaccounted mortality were subjectively categorized within metapopulation areas based on the timing and location of fisheries removals relative to the importance of the target species in sea lion diets, critical stages of sea lion development within seasons, and potential of overlap between fisheries removals and sea lion foraging.

Spatial apportionments under Alternative 5 result in estimated daily average fish removal rates similar to those of Alternatives 3 and 4 for Eastern Bering Sea pollock and Pacific cod (Figure 4.1-5, Figure 4.1-6). Relative to Alternative 1, the removals are evened out over the seasons (Figure 4.1-5). Conversely, they are bimodal with peak removal rates of Atka mackerel Pacific cod, and pollock in spring and autumn from Aleutian Island fishing areas (Figure 4.1-7), though of much lower magnitude (Figure 4.1-8). Compared to other alternatives, estimated daily average removal rates from Aleutian Islands areas are lower during critical spring and summer months than in the other alternatives (Figure 4.1-8). Pacific cod and pollock estimated average daily removal rates in the Gulf of Alaska are most similar to the seasonal distribution of Alternative 4 (Figure 4.1-9), and results in stepwise decreases from winter to summer (Figure 4.1-10).

Alternative 5 also has a series of regional closures and apportionments to reduce spatial fishery concentration. As with other alternatives, an Aleutian Island pollock fishing prohibition may be of marginal benefit to Steller sea lions because pollock are not a key item of Steller sea lion diet west of 170°W longitude (Figure 4.1-11, Figure 4.1-12). Catch limits and multiple seasons within critical habitat reduce the rate at which fish are harvested, though as with the other alternatives, the benefit to Steller sea lions is unclear, given seasonal movements of sea lions among areas, much greater home ranges during winter (see Section 3.1.1.7.2) and the variable amount of foraging occurring inside critical habitat even within a single foraging trip (Figure 4.1-13, Figure 4.1-14).

Alternative 5 measures result in marginally less spatial and temporal concentration of fishery removals of key Steller sea lion prey species than do measures under Alternative 1, and is therefore rated insignificant (Table 4.1-7) under the criteria established for significance in Table 4.1-1. TAC levels are similar to those of the other alternatives except for Alternative 2, and hence the ultimate benefit to the sea lion population may not be as great. Based upon sea lion population trends during 1990-2000, it is assumed that Alternative 5 will not result in a stable population. Thus, changes to the sea lion population would be within 2% of the current trend, and an overall decline would continue at -3.3% to -5.2% per year (Table 4.1-6).

Indirect Effects - Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on Steller sea lions cannot be demonstrated with existing data. Alternative 5 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 10 or 20 nm of 37 rookeries to trawling year-round. It also contains a reduction in TAC of 92% for pollock in the Aleutian Islands (bycatch only), which is an overall reduction of less than 1% for the groundfish TAC for pollock, Pacific cod, and Atka mackerel, resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established in Table 4.1-1, measures which would result in even less disturbance than that which is insignificant are also rated as insignificant (Table 4.1-7).

4.1.1.6 Summary of Effects, Experimental Design Potential, and Re-initiation of Section 7 Consultation for Steller Sea Lions

In conclusion, significance determinations suggests that the effects of the alternatives on Steller sea lion are insignificant for all five alternatives with regard to the questions of incidental take/ entanglement in marine debris, harvest of prey species, and disturbance (Table 4.1-7). On the question for spatial and temporal concentration of the fisheries, Alternative 1 was found to have a conditionally significant negative effect, Alternatives 2 and 3 were found to have a conditionally significant positive effect (Table 4.1-7). Alternatives 3 through 5 generally add additional provisions to spread fisheries harvests over time and areas in an attempt to reduce the likelihood of localized depletions on a broad range (from coarse to fine) of spatial/temporal scales. These alternative management schemes, in particular Alternatives 2 (Low and Slow) and 4 (Area and Fishery Specific Approach), have reached a fine degree of resolution for which harvests are apportioned among areas, seasons, and gear types. Unfortunately, the resolution at which Steller sea lion and other marine mammal foraging behavior is understood is at much coarser temporal and spatial scales than the proposed fishery management measures. Much about the effects determinations remain unknown. Thus analyses involving reductions in TAC, or broad scale seasonal or regional allocations could be more readily evaluated within the context of current understanding of marine mammal foraging and life histories than could effects of small scale (within several nautical miles) or patchwork fishery limits or closures. Alternatives which were rated insignificant for one or more elements do contain measures which would be expected to have some beneficial impacts on localized populations of Steller sea lions however these localized impacts are not expected to be sufficient to reverse of the downward trajectory of the endangered western population of Steller sea lion number and hence were deemed insignificant.

Experimental Design Potential

The management regime proposed in Alternative 3 is similar to that in the NMFS 2000 Biological Opinion (NMFS, 2000a) and the monitoring program suggested therein could be applied to the Alternatives. Because of the reduced level of the sea lion population at present, however, implementation and success of the monitoring scheme may be difficult to gauge. Prior to the 2000 Biological Opinion experimental design, NMFS planned an experiment to test the efficacy of the no-trawl zones. It may be applicable to all the alternatives (NMFS, 1999c). All Steller sea lion fishery management measures include the presumption that fisheries cause reduced prey availability to sea lions or that by manipulation of the fishery, sea lion population trends will be effected. The efficacy of no-trawl zones experiment (NMFS 1999c) includes two studies addressing the possible effects of fishing on prey abundance and distribution. The first study has begun at Seguam Island and will address Atka mackerel issues, and the second study at Kodiak Island is

addressing walleye pollock biology. Both studies are designed to determine whether fisheries result in localized depletion of the target fish, and if so, whether or not Steller sea lions may be compromised because of the depletion of prey. Both studies began in the late 1990s and will require five or more years to complete. Some physiological, behavioral, and ecological variants appropriate to measure to demonstrate food limitation, and by inference, localized depletion, are discussed in the study plan.

Re-initiation of Consultation under Section 7 of the ESA is appropriate for the proposed action

Section 402.16(c) requires re-initiation of consultation on an action "if the identified action is subsequently modified in a manner that caused an effect to the listed species or critical habitat that was not considered in the biological opinion..." The NMFS 2000 Biological Opinion was a comprehensive analysis of the BSAI and GOA groundfish fisheries and for all species listed as endangered or threatened. The proposed action, however, contain modifications to fishery management measures for pollock, Pacific cod and Atka mackerel fisheries to protect Steller sea lion that are different than the specific fishery management measures that were analyzed in the 2000 Biological Opinion. Because the determination of what constitutes differences in management measures that may be important to the determination of jeopardy to the listed Steller sea lion or adverse modification of critical habitat is quite subjective, the agency determined re-initiation of consultation is appropriate.

Section 402.16(b) also requires re-initiation of formal consultation "if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered...". Since the 2000 Biological Opinion, new information about Steller sea lion movements based on telemetry studies and new analysis of Steller sea lion scat samples have become available. An examination of that information as it relates to necessary protection measures is warranted.

NMFS recognized consultation under Section 7 of the ESA was appropriate early in this process. The consultation, limited in scope to Alternative 4, proceeded in parallel with preparation of this analysis. The draft Biological Opinion was contained in the draft SEIS (Appendix A). As such, the draft Biological Opinion underwent public review with the draft analysis (see Comments and Response to Comments in Volume III of this final SEIS).

Table 4.1-1 Criteria for determining significance of effects to pinnipeds and sea otters.

Effects	Score					
	S-	CS-	I	CS+	S+	U
Incidental take/entanglement in marine debris	Take rate increases by >50%	Take rate increases by 25-50%	Level of take below that which would have an effect on population trajectories	NA	NA	Insufficient information available on take rates
Harvest of prey species	Deviation of average daily removal rates is >+251; TAC removals of one or more key prey species increased by more than 5%	Deviation of average daily removal rates is +101 to +250; TAC removals of one or more key prey species increased or reduced from 1998 levels by less than 5%	Deviation of average daily removal rates is ± 100 ; TAC removals of one or more key prey species reduced by 5-20%	Deviation of average daily removal rates is -101 to -250; TAC removals of one or more key prey species reduced from 1998 levels by more than 20%	Deviation of average daily removal rates is <-251; TAC removals of all key prey species (pollock, Pacific cod, Atka mackerel) reduced by more than 20%	Insufficient information available on key prey species
Spatial/temporal concentration of fishery	Much more temporal and spatial concentration in all key areas	Similar temporal and spatial fishery distribution in some, but not all, key areas	Marginally less temporal and spatial concentration than 1998 fisheries	Much less temporal and spatial concentration in some, but not all key areas	Much less temporal and spatial concentration in all key areas	Insufficient information as to what constitutes a key area
Disturbance	Much more disturbance (all closed areas reopened)	Marginally more disturbance (some closed areas reopened)	Similar level of disturbance as that which was occurring in 1998	NA	NA	Insufficient information as to what constitutes disturbance

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown

NA = Not Applicable

TAC = Total Allowable Catch

Percentages used in determining the significance of effects are given as a plausible point of departure to initiate discussion as opposed to being deemed statistically meaningful per se. Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to Steller sea lion populations. The ideal level is undoubtedly zero, however even a reduction to zero is considered to be insignificant to pinniped and sea otter populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. A similar interpretation of significance has been made for disturbance effects on pinnipeds and sea otters. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant, the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to Steller sea lion populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. In establishing criteria for rating the significance to pinniped and sea otter populations of management measures affecting the harvest levels to be established for

prey species and the temporal and spatial concentrations of harvest NMFS considered management measures resulting in similar levels of TAC removals and similar temporal and spatial patterns of harvest as in 1998 to be conditional significant negative and that to achieve a rating of insignificant marginal reductions in TAC levels or marginal decreases in the concentration temporal and spatial patterns of the fisheries must be reasonably expected to occur as a result of the implementation of the management measures contained in the alternative under consideration. To achieve ratings of conditionally significant positive or significantly positive substantial reductions in TAC levels or substantial decreases in the temporal and spatial concentrations to some or all key prey species and to some or all key pinniped or sea otter foraging areas must be reasonably expected to occur as a result of the implementation of the management measures contained in the alternative under consideration.

Table 4.1-2 Estimated incidental take of Steller sea lions and other marine mammals by commercial pollock, Pacific cod, and Atka mackerel fisheries under each alternative.

Fishery and Area	Species or Group	1		2		3		4		5	
		Mean	CI	Mean	CI	Mean	CI	Mean	CI	Mean	CI
Eastern Bering Sea Pollock (areas 508 to 530) (Trawl gear only)	Steller sea lion	5	3-7	5	3-7	5	3-7	5	3-7	5	3-7
	All marine mammals	18	15-21	18	15-21	18	15-21	18	15-21	18	15-21
Aleutian Islands Pollock (areas 541,542,543) (Trawl gear only)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
GOA Pollock (W&C) (areas 610,620,630) (All gears)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
	All marine mammals	3	0-8	1	0-6	2	0-7	3	0-8	3	0-8
<i>Pollock subtotal</i>	Steller sea lion	7	5-9	7	5-9	7	5-9	7	5-9	7	5-9
	All marine mammals	22	16-28	20	14-26	21	15-27	22	16-28	22	16-28
Bering Sea Pacific cod (areas 508 to 530) (All gears)	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
	All marine mammals	3	0-6	2	0-5	3	0-6	3	0-6	3	0-6
Aleutian Islands Pacific cod (areas 541,542,543) (All gears)	Steller sea lion	0	0-1	1	0-2	1	0-2	0	0-1	1	0-2
	All marine mammals	0	0-2	1	0-3	1	0-3	0	0-2	1	0-3
WGOA Pacific cod (area 610) (All gears)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
	All marine mammals	2	0-7	1	0-6	2	0-7	2	0-7	2	0-7
CGOA Pacific cod (areas 620,630) (All gears)	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
EGOA Pacific cod (area 640) (All gears)	Steller sea lion	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
	All marine mammals	0	0-0	0	0-0	0	0-0	0	0-0	0	0-0
<i>Pacific cod subtotal</i>	Steller sea lion	2	0-4	3	1-5	3	1-5	2	0-4	3	1-5
	All marine mammals	6	0-12	5	0-11	7	1-13	6	0-12	7	1-13
EBSAI Atka mackerel (Areas 508 to 541) (All gears)	Steller sea lion	1	0-3	1	0-3	1	0-3	1	0-3	1	0-3
	All marine mammals	1	0-4	1	0-4	1	0-4	1	0-4	1	0-4
WAI Atka mackerel (Area 543)	Steller sea lion	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
	All marine mammals	1	0-2	1	0-2	1	0-2	1	0-2	1	0-2
CAI Atka mackerel (Area 542)	Steller sea lion	2	1-3	1	0-2	2	1-3	2	1-3	2	1-3
	All marine mammals	2	0-4	1	0-3	2	0-4	2	0-4	2	0-4
<i>Atka mackerel subtotal</i>	Steller sea lion	4	2-6	3	1-5	4	2-6	4	2-6	4	2-6
	All marine mammals	4	0-8	3	0-7	4	0-8	4	0-8	4	0-8
All Fisheries Combined (Areas 508 to 640) (All gears)	Steller sea lion	13	10-16	13	10-16	14	11-17	13	10-16	14	11-17
	All marine mammals	32	23-41	28	19-37	32	23-41	32	23-41	33	24-42
Percentage difference relative to Alternative 1											
All Fisheries Combined	Steller sea lion			0%		8%		0%		8%	
(Areas 508 to 640) (All gears)	All marine mammals			-13%		0%		0%		3%	

Table 4.1-3. Yearly sum of relative mean daily removal rate deviates (deviation difference) based on projected allocations of total allowable catch for each Alternative. Deviates are not additive within columns.

Fishery and Area	Alternative				
	1	2	3	4	5
Pollock (all areas)	-59	154	-27	-29	-40
Eastern Bering Sea pollock	-91	198	-36	-36	-36
Aleutian Islands pollock	-55	-346	277	470	-346
GOA pollock	118	-120	169	-75	-93
WGOA pollock	96	-128	231	-99	-100
CGOA pollock	133	-114	131	-64	-87
Pacific cod (all areas)	20	-141	-57	202	-23
Bering Sea/AI Pacific cod	-24	-80	-19	152	-29
Aleutian Islands Pacific cod	104	-250	-196	505	-163
GOA Pacific cod	-5	-150	20	24	112
WGOA Pacific cod	17	-144	-30	29	127
CGOA Pacific cod	-19	-154	49	20	102
Atka mackerel (all areas)	149	-65	115	-84	-115
EBSAI Atka mackerel	-103	63	194	-62	-92
WAI Atka mackerel	-41	144	101	-91	-114
CAI Atka mackerel	180	-87	118	-95	-116
All Fisheries and Areas	-15	38	-49	58	-31

Table 4.1-4 Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Eastern Bering Sea pollock	TAC (mt)	1,400,000	1,372,290	1,400,000	1,400,000	1,400,000
	Change from Alt. 1 (mt)		-27,710	0	0	0
	Change from Alt. 1 (%)		-2%	0%	0%	0%
Aleutian Islands pollock	TAC (mt)	23,800	2,000	23,800	23,800	2,000
	Change from Alt. 1 (mt)		-21,800	0	0	-21,800
	Change from Alt. 1 (%)		-92%	0%	0%	-92%
GOA pollock Subtotal	TAC (mt)	99,349	44,509	81,882	99,351	99,349
	Change from Alt. 1 (mt)		-54,840	-17,467	2	0
	Change from Alt. 1 (%)		-55%	-18%	0%	0%
WGOA pollock	TAC (mt)	34,474	15,438	29,440	34,460	34,474
	Change from Alt. 1 (mt)		-19,036	-5,034	-14	0
	Change from Alt. 1 (%)		-55%	-15%	0%	0%
CGOA pollock	TAC (mt)	62,391	27,972	50,420	62,437	62,391
	Change from Alt. 1 (mt)		-34,419	-11,971	46	0
	Change from Alt. 1 (%)		-55%	-19%	0%	0%
EGOA pollock	TAC (mt)	2,484	1,099	2,022	2,454	2,484
	Change from Alt. 1 (mt)		-1,385	-462	-30	0
	Change from Alt. 1 (%)		-56%	-19%	-1%	0%
<i>Pollock subtotal</i>						
	TAC (mt)	1,523,149	1,418,799	1,505,682	1,523,151	1,501,349
	Change from Alt. 1 (mt)		-104,350	-17,467	2	-21,800
	Change from Alt. 1 (%)		-7%	-1%	0%	-1%
Bering Sea/AI Pacific cod	TAC (mt)	188,000	153,652	188,000	188,000	188,000
	Change from Alt. 1 (mt)		-34,348	0	0	0
	Change from Alt. 1 (%)		-18%	0%	0%	0%
GOA Pacific cod subtotal	TAC (mt)	50,848	31,639	50,848	50,848	50,848
	Change from Alt. 1 (mt)		-19,209	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
WGOA Pacific cod	TAC (mt)	18,300	11,390	18,300	18,300	18,300
	Change from Alt. 1 (mt)		-6,910	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
CGOA Pacific cod	TAC (mt)	28,988	18,034	28,988	28,988	28,988
	Change from Alt. 1 (mt)		-10,954	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
EGOA Pacific cod	TAC (mt)	3,560	2,215	3,560	3,560	3,560
	Change from Alt. 1 (mt)		-1,345	0	0	0
	Change from Alt. 1 (%)		-38%	0%	0%	0%
<i>Pacific cod subtotal</i>						
	TAC (mt)	238,848	185,291	238,848	238,848	238,848
	Change from Alt. 1 (mt)		-53,557	0	0	0
	Change from Alt. 1 (%)		-22%	0%	0%	0%






Table 4.1-4 Continued. Projected total annual catch (TAC) for Eastern Bering Sea, Aleutian Islands, and Gulf of Alaska pollock, Pacific cod, and Atka mackerel by fishery area.

Fishery and Area		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
EBSAI Atka mackerel	TAC (mt)	7,800	4,753	7,800	7,800	7,800
	Change from Alt. 1 (mt)		-3,047	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
WAI Atka mackerel	TAC (mt)	27900	16,993	27900	27900	27900
	Change from Alt. 1 (mt)		-10,907	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
CAI Atka mackerel	TAC (mt)	33600	20,462	33600	33600	33600
	Change from Alt. 1 (mt)		-13,138	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
<i>Atka mackerel subtotal</i>						
	TAC (mt)	69,300	42,207	69,300	69,300	69,300
	Change from Alt. 1 (mt)		-27,093	0	0	0
	Change from Alt. 1 (%)		-39%	0%	0%	0%
Combined Total						
	TAC (mt)	1,831,297	1,646,297	1,813,830	1,831,299	1,809,497
	Change from Alt. 1 (mt)		-185,000	-17,467	2	-21,800
	Change from Alt. 1 (%)		-10%	-1%	0%	-1%

Table 4.1-5 Root mean square error (RMSE) index incorporating total allowable catch (TAC) and estimated daily catch rate variability compared to a baseline annual harvest of 1.6% of target species standing biomass. Smaller RMSE values reflect lower TAC or decreased variability of daily catch rate.

Fishery and Area	Alternative				
	1	2	3	4	5
Eastern Bering Sea Pollock	5,884	3,555	3,961	3,961	3,961
Aleutian Islands Pollock	133	3	68	62	7
Gulf of Alaska Pollock	387	114	396	409	425
Bering Sea and Aleutian Islands Pacific Cod	342	363	503	588	496
Gulf of Alaska Pacific Cod	101	76	171	109	195
Bering Sea and Aleutian Islands Atka Mackerel	25	13	22	21	25
All Fisheries and Areas	6,426	4,099	5,112	4,854	4,921

Table 4.1-6 Intensity of effects categories (harvest of prey species and spatial/temporal concentration) and associated percent increase to population, and new population trends for Steller sea lions.

Intensity of Effect ¹	Observed Percent Annual Change to Population	New Annual Population Trend (r, %/yr) ²
 Much less	12	6.2
	11	5.3
	10	4.3
	9	3.4
	8	2.4
	7	1.5
	6	0.5
 Marginally less	5	-0.4
	4	-1.4
 Marginally more	3	-2.3
	2	-3.3
 Same	1	-4.2
	0	-5.2
	-1	-6.1
	-2	-7.1
 Much more	-3	-8.0
	-4	-9.0
	-5	-9.9
	-6	-10.9
	-7	-11.8
	-8	-12.8
	-9	-13.7
	-10	-14.7

¹ Note: Intensity of effect combined for harvest of prey species and spatial/temporal concentration.

² Note: base trend is current overall annual decline rate of -5.18%.

Table 4.1-7 Summary of effects of Alternatives 1 through 5 on Steller sea lion.

Steller Sea Lion	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS+	CS+	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.1.2 Effects on Other ESA Listed Cetaceans (Listed Great Whales)

Seven species of large whales that occur in Alaskan waters are listed under the ESA including: the North Pacific right whale, blue whale, fin whale, sei whale, humpback whale, sperm whale, and bowhead whale. Each proposed alternative will be discussed in terms of four potential effects on these whales: 1) direct (or incidental) take/entanglement in marine debris, 2) harvest of prey species, 3) temporal/spatial concentration of the fishery, and 4) disturbance. Direct interactions with groundfish fishery vessels have been documented between 1989 and 2000 for three of the seven species: fin, humpback, and sperm whales. Several cases of entanglements in marine debris also have been reported for humpback and bowhead whales. Four of the seven species listed consume groundfish as part of their diet: fin, sei, humpback, and sperm whales. Discussions of each potential effect will focus principally on the species noted above.

The criteria for determining significance of effect in this and cetacean species groups is outlined in Table 4.1-7 differs from those developed specifically for pinnipeds and sea otters (Table 4.1-1). The differences are with respect to rating significance and insignificance for the questions of harvest of prey species and spatial/temporal concentration of fishery.

Direct (or Incidental) Take/Entanglement in Marine Debris

Direct mortalities of endangered whales from entanglement in fishing gear have been observed and reported infrequently in the groundfish fishery. Since 1989, three of the seven listed species have been killed incidental to the fishery. The criteria for determining significance of incidental take (Table 4.1-7) were applied to evaluate level of take for each alternative. Total allowable catch was used to project incidental take within each fishery (Table 4.1-2). A rating of insignificant is, therefore, a take rate that is below that which would have an effect on population trajectories. A rating of conditionally significant negative is a take rate that increases by 25% to 50% the average annual incidental take for the years 1996-2000. A rating of significantly negative is a take rate that increases by more than 50% the average annual incidental take for the years 1996-2000. Increasing take rate significance ratings in increments of 25% are coupled more with scientific uncertainty about knowledge of the actual take rate more than indicating progressively negative degrees of significance (Table 4.1-7). Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtedly zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. Closures to fishing areas were also considered when evaluating this effect by comparing the portion of takes that occurred within proposed closed areas to total incidental take for the fishery from 1989-1999.

A single fin whale mortality was reported in the GOA pollock trawl fishery operating south of Kodiak Island and Shelikof Strait in autumn 1999. Fin whales were reported in this region year-round, most often in the summer and autumn (POP, 1997). The mortality may have been the result of prey competition, although pollock have not been identified as a key prey species of fin whales in the GOA (see Harvest of Prey Species, next page). Humpback whales are present year-round in Alaska waters but are most frequently reported during the summer and autumn. In 1997, a dead humpback was found entangled in netting and trailing orange buoys near the Bering Strait. It is often difficult to determine if the entanglement occurred with active or derelict gear, or to identify the fishery the derelict gear originated from. Two mortalities (in October 1998 and February 1999) were reported by observers in the BS pollock trawl fishery operating near Unimak Pass. The extent of interactions between bowhead whales and the groundfish fishery are not known. Bowhead whales are present in the Bering Sea during winter and early spring but are usually associated with ice-covered regions. Rope entanglement injuries and deaths as well as ship-strike injuries appear to be rare. Of 236 bowhead whales examined from the Alaskan subsistence harvest (from 1976 to 1992), three had visible ship-strike injuries from unknown sources and six had ropes attached or scars from fishing gear (primarily pot gear), one found dead was entangled in ropes similar to those used with fishing gear in the Bering Sea (Philo *et al.*, 1992). Since 1992, additional bowhead whales have been observed entangled in pot gear or with scars from ropes.¹⁰ Sperm whale interactions with the groundfish fishery have primarily been documented in the GOA longline fishery targeting sablefish in management zones 640 and 650 (Hill *et al.*, 1999). Two of the three entanglements reported between 1997 and 2000 resulted in release of the animal without serious injury. The extent of the injuries to the third animal was not known though it was alive at the time of release.

Harvest of Prey Species

One or more of the target species (pollock, Atka mackerel and Pacific cod) of the GOA and BSAI groundfish fisheries have been identified as prey species of fin, sei, humpback, and sperm whales. To evaluate changes to the harvest of prey for each alternative, significance criteria were developed as described above in Section 4.1 with respect to deviation differences of average daily removal rates, and spanning TAC removals ranging from more than 5% to 20% compared to projected TAC for Alternative 1. Therefore, where removals of one or more key prey species of cetaceans remains the same (within $\pm 5\%$) as that proposed in past TACs, or the deviation difference was ± 100 , a rating of insignificant is given. Decreasing and increasing removals of prey species result in significance ratings that are progressively positive and negative, respectively (Table 4.1-8). Sizes of prey species consumed by cetaceans, where available, were also considered when evaluating this effect.

The consumption of pollock by fin whales appears to increase in years where euphausiid and copepod abundance is low (Nemoto, 1957; 1959). Regional variation in diet has also been documented. Pollock consumption was greatest in fin whales occupying shelf waters of the Bering Sea while this prey item was not found in animals in the GOA or western North Pacific Ocean (Kawamura, 1982). Pollock consumed were less than 11.7 in (30 cm) in length, within the size range targeted by the fishery: 5.9- 19.5 in (15-50 cm). Atka mackerel and Pacific cod have also been identified as prey of fin whales though their importance is not known. The diet of sei whales is comprised almost entirely of copepods. Although young mackerel and other small schooling fish were present in a few of the sei whale stomachs sampled in Japan waters, these fish species also prey on copepods and may have been consumed incidentally (Nemoto and Kawamura, 1977). Atka mackerel and walleye pollock are preferred prey species of humpback whales found in waters near the Aleutian Islands (Nemoto, 1959). Atka mackerel consumed were between 5.8-11.7 in (15-30 cm)

¹⁰J.C. George, "Personal Communication," North Slope Borough, P.O. Box 69, Barrow, AK 99723

in length, and were probably juveniles (adult fish targeted by the fishery usually ranged in size from 14-19 in (35-50 cm; Fritz and Lowe, 1998). Walleye pollock eaten by humpback whales were identified as adults but lengths were not provided (Nemoto, 1959). Other important prey species include euphausiids, herring, anchovy, eulachon, capelin, saffron cod, sand lance, Arctic cod, rockfish, and salmon. Sperm whales feed primarily on mesopelagic squid, however, fish consumption becomes more evident near the continental shelf break and along the Aleutian Islands (Okutani and Nemoto, 1964). Diet composition of sperm whales in the Bering Sea is roughly 70% - 90% squids and 10% - 30% fish which include Atka mackerel, Pacific cod, pollock, salmon, lantern fishes, lancetfish, saffron cod, rockfishes, sablefish, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin, 1967; Kawakami, 1980; Rice, 1986a). Pollock do not appear to be a key prey species in any area but have been observed in whales taken in the northwestern Pacific (Kawakami, 1980). The importance of Pacific cod and Atka mackerel to sperm whales is not known (Yang, 1999).

Temporal/Spatial Concentration of Fishery

Proposed changes to the fishery include area closures, season closures, and seasonal allocations of TAC. Temporal and spatial concentration criteria qualitatively rate the significance of the effect of the alternatives on the ESA listed great whales. A rating of insignificant indicates the same temporal and spatial distribution of the fishery, while "marginally" less or more temporal or spatial concentration of the fisheries yields a rating of conditionally significant positive or negative, respectively, and "much" less or more yields a rating of significantly positive or negative, respectively. For those species where prey competition is not evident or changes in TAC are not greater than $\pm 5\%$ under an alternative, increases or decreases in concentrations of fish removals will have an insignificant effect. However, area and season closures may benefit these species by reducing incidental interactions and disturbance.

Disturbance

The effects of disturbance caused by vessel traffic, fishing operations, or underwater noise associated with these activities on baleen whales (North Pacific right, blue, fin, sei, humpback, and bowhead whales) and toothed whales (sperm whales) in the GOA and BSAI are largely unknown. Most baleen whales appear to tolerate or habituate to fishing activity, at least as suggested by their reactions at the surface. Collisions with ships have been a major source of mortality of North Atlantic right whales (Kenney and Kraus, 1993). Blue, fin, and sei whales react strongly by diving or moving away when vessels approach on a direct course or make fast erratic approaches (reviewed in Richardson *et al.*, 1995). Humpback reactions to vessels are highly variable. Observed short-term effects have included avoidance and on rare occasions "charging" at the vessel while long-term effects included abandoning high-use areas (reviewed in Richardson *et al.*, 1995). However, long-term negative effects were not apparent at the population level (Bauer *et al.*, 1993). Bowheads often attempt to outswim vessels, turning perpendicular away from the vessel track only when the ship is about to overtake it. Displacement can be as much as a few kilometers while fleeing (Richardson *et al.*, 1995). When chased, sperm whales often change direction and travel long distances underwater (Lockyer, 1977). However, sperm whales sometimes accompany vessels for extended periods of time when the vessels are operating nonaggressively (e.g., GOA sablefish longline fishery). Reaction to gear, such as pelagic trawls is unknown, although the rarity of incidental takes suggests either partitioning or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary.

Vessel noise and the routine use of various sonar devices are audible to whales and may be disturbance sources. When disturbed by vessels: right whales were consistently silent (Watkins, 1986), fin whales

continued to vocalize but low-frequency vessel noise often masked social calls (Edds, 1988), and humpbacks tended to be silent when vessels were near (Watkins, 1986). Wintering humpback whales have been observed reacting to sonar pulses by moving away (Maybaum, 1990; 1993). Bowheads stopped calling after bombs were detonated during the Native subsistence harvest.¹¹ Calling behavior of sperm whales was little affected by boats (Gordon *et al.*, 1992), however, sperm whales sometimes fell silent when they heard acoustic pingers pulsed at low levels, 6-13 kHz (Watkins and Schevill, 1975). The criteria used to describe the disturbance effects of the alternative are qualitative. A rating of insignificant indicates the same level of disturbance, while "marginally" more disturbance results in a rating of conditionally significant negative, and "much" more results in a rating of significantly negative. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant, the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis.

4.1.2.1 Effects of Alternative 1 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Under Alternative 1, the take rate for the pollock fishery would not change greater than $\pm 25\%$, therefore, the intensity of this effect is rated insignificant. Assuming only one Alaska stock of fin whales exists, population level effects would be insignificant. Estimated incidental take rates for the fisheries operating where the humpback whale mortalities occurred (EBS Pollock and EBSAI Mackerel) would not change greater than $\pm 25\%$ under Alternative 1, therefore, the intensity of this effect is rated insignificant (Table 4.1-7). Although take levels are low, the western North Pacific stock numbers below 400 whales and rates of mortality and serious injury cannot be considered insignificant and approaching zero (Angliss *et al.*, 2001). Population level effects are uncertain because it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. Changes to groundfish fishery operations in the Bering Sea would not alter incidental take by more than $\pm 25\%$, therefore, the intensity of this effect is rated insignificant for bowhead whales. Population level effects would be insignificant given the current increasing trend in abundance of Bering Sea bowhead whales under a managed subsistence harvest. Alternative 1 does not propose changes to the sablefish longline fishery where all incidental takes of sperm whales have occurred, therefore, the intensity of this effect is rated insignificant. Population level effects are uncertain because reliable abundance estimates are not available for the North Pacific stock.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

Assuming pollock represent a key prey species to EBS fin whales, the projected deviation difference of average daily removal rates (see 4.1.1.1 for description) for pollock under this Alternative is -91 (Table 4.1-3), and changes to TAC do not exceed 2% (Table 4.1-4), both resulting in insignificant effects (Table 4.1-8). Bycatch of other fin whale prey (herring, capelin, arctic cod, saffron cod, Pacific cod, Atka mackerel, rockfishes, smelt and salmon) in the Bering Sea Pollock Fishery does not exceed 1% for each of these species

¹¹Ibid.

(NMFS unpublished observer data)¹². Because removals of key prey species do not change greater than $\pm 5\%$, and the overall deviation difference of relative mean daily removals of pollock is -59 (Table 4.1-3), the intensity of this effect is rated insignificant for fin whales. The intensity of this effect is also rated insignificant for sei whales. Under Alternative 1, TAC changes proposed for the Atka mackerel fishery would not be greater than $\pm 5\%$, and bycatch of Atka mackerel in all other groundfish fisheries is well below 1% of total catch (NMFS unpublished observer data)¹³.

Sightings of humpback whales reported in the POP database occurred more frequently in regions utilized by the EBS and GOA pollock fisheries and the BS EAI Atka mackerel fishery (compared to other reported species such as sperm whales, minke whales, killer whales, and Dall's porpoise that were also found in AI pollock and CAI Atka mackerel fishery management zones). Changes proposed for the EBS and GOA Pollock TAC and BS EAI Atka Mackerel TAC are not greater than $\pm 5\%$ for Alternative 1 (Table 4.1-4). Bycatch summaries for other prey species do not exceed 1% except rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback whales, the intensity of this effect is rated insignificant under Alternative 1.

Sperm whales have been observed preying on sablefish caught on commercial longline gear in the GOA (Hill *et al.*, 1999). Bycatch of sablefish for the entire GOA fishery is roughly 7% of total catch (NMFS unpublished observer data).¹⁴ Assuming sablefish are a key prey species of sperm whales in the GOA, removals of this species do not change greater than $\pm 5\%$ and the intensity of this effect is rated insignificant.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Prey competition is not evident or changes in TAC are not greater than $\pm 5\%$ for fin, sei and sperm whales, therefore, temporal and spatial concentration of fish removals would have an insignificant effect. For humpback whales, where prey competition may be occurring and TAC does change, the extent of prey overlap may be low because these whales appear to be consuming mostly juvenile fish while the fishery is targeting adults. Therefore, any increase or decrease in concentrations of prey removed would not necessarily effect this species at a population level. The intensity of this effect is rated insignificant under Alternative 1.

Indirect Effects - Disturbance Effects (Question 4)

Given the continued occupation of the fishing grounds by these animals, disturbance from vessels and sonar, if it occurs in the BSAI or GOA, does not appear to have population level effects though it may disrupt communication temporarily. The intensity of this effect is rated insignificant (same level of disturbance) under Alternative 1.

¹²D. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.

¹³Ibid.

¹⁴Ibid.

4.1.2.2 Effects of Alternative 2 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is -13% under Alternative 2, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). However, under this Alternative, the region where the fin whale mortality occurred would be closed to trawl fishing. While this may benefit fin whales occupying Shelikof Strait it is not known whether these whales represent a distinct segment of the population. Assuming only one Alaska stock exists, population level effects would be insignificant. For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 2 could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-7). For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for bowhead and sperm whales under Alternatives 2.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

The deviation difference for pollock in the Bering Sea resulted in +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for fin whales. For sei whales that occasionally consume Atka mackerel, TAC for the BSAI Atka mackerel fishery is reduced by 67%, but it is unlikely that the TAC changes proposed would effect sei whales at the population level because Atka mackerel do not appear to be key prey for this species, therefore this effect is rated insignificant under Alternative 2. For humpback whales, changes proposed for the EBS pollock TAC are not greater than $\pm 5\%$, though the GOA pollock fishery TAC would be reduced by 54% and the BS EAI Atka mackerel TAC would be reduced by 67%. The result is an 8% reduction in TAC under Alternative 2 (Table 4.1-4). Deviation differences of summed relative mean daily removal rates (see 4.1.1.1 for explanation) are -120 for GOA pollock, and +63 for EBSAI Atka mackerel (Table 4.1-3), and +154 for the pollock fishery overall and -65 for the overall Atka mackerel fishery. Bycatch summaries for other prey species do not exceed 1% except for rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback whales, the intensity of this effect is rated conditionally significant positive (Table 4.1-8) with respect to TAC (5%-20% reduction in TAC of one or more key prey species) for humpback whales. The significance of this effect is uncertain because it is not known if humpback whales are exclusively consuming groundfish within these fishery management zones or what portion of the central and western Alaska stocks utilize these areas. Thus, the combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS+ resulted in an overall ranking of insignificant for this Alternative under question 2 for humpback whales. For sperm whales, bycatch of sablefish for the entire GOA fishery is roughly 7% for all Alternatives

except Alternative 2, where it increases to a little over 12% (NMFS unpublished observer data)¹⁵. Assuming sablefish are a key prey species of sperm whales in the GOA, removals of this species do not change greater than $\pm 5\%$ so the intensity of this effect is rated insignificant.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 2.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 2.

4.1.2.3 Effects of Alternative 3 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) do not change under Alternative 3, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 3 could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-6). For the same reasons listed under Alternative 1, the intensity of this effect would be insignificant for fin, bowhead, and sperm whales under Alternative 3.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For Alternative 3, the deviation difference for pollock in the Bering Sea resulted in -36 (I), but high variability occurred by area with the Aleutian Islands ranking as S-, and all other areas as CS-. Atka mackerel removals under Alternative 3 all resulted in positive values with a CS- ranking for the EBSAI area and insignificant for other areas (Table 4.1-3). Overall, Alternative 3 had a -49 value, suggesting less fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of -49, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for fin, sei, and sperm whales under Alternative 3 (Table 4.1-9). For humpback whales changes proposed for the EBS Pollock TAC are not greater than $\pm 5\%$. However, under Alternative 3, the GOA Pollock Fishery TAC would be reduced by 15%. The result is a 1% reduction in TAC overall under Alternative 3 (calculated from Table 4.1-4). Bycatch summaries for other prey species do not exceed 1% except for rockfishes (which do not exceed 7% of the total catch). Assuming pollock and Atka mackerel are key prey species of humpback

¹⁵Ibid.

whales, the intensity of this effect is rated conditionally significant positive Table 4.1-9) under Alternative 3 (same removals of one or more key prey species ($\pm 5\%$)) for TAC. Overall however the significance of TAC reductions under Alternative 3 is unknown because it is not known if humpback whales are exclusively consuming groundfish within these fishery management zones or what portion of the central and western Alaska stocks utilize these areas. Combined with the combination of a negative average daily removal rate (deviation difference) resulting in an insignificant rating, and the analyst assigned an overall ranking of insignificant for humpback whales under question 2.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 3.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 3.

4.1.2.4 Effects of Alternative 4 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 4.

4.1.2.5 Effects of Alternative 5 on ESA Listed Cetaceans

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is +3% under Alternative 5, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). Area closures proposed under Alternative 5 do not include the region where the fin whale mortality occurred. For humpback whales, area closures to pollock and trawl fishing proposed under Alternatives 5

could potentially reduce interactions (closures include the area where the two mortalities occurred). The significance of this effect may be beneficial for humpback whales given it is not known what portion of the western North Pacific stock utilizes these areas and whether gear entangling some whales originated from the U.S. groundfish fishery. However the potential for reducing takes from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-6). For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for bowhead and sperm whales under Alternative 5.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all great whales under Alternative 5.

4.1.2.6 Summary of Effects and Re-initiation of Section 7 Consultation on ESA Listed Cetaceans

The criteria for determining significance of effect in this and other cetacean species groups presented below in Table 4.1-8 differs from those developed specifically for pinnipeds and sea otters (Table 4.1-1). The differences are with respect to rating significance and insignificance for the questions of harvest of prey species and spatial/ temporal concentration of fishery. Harvest levels of prey species and the temporal and spatial concentration of fisheries with levels and patterns similar to those of 1998 are considered to have insignificant effects on cetacean populations in consideration of these species life histories, dependence upon pollock, Pacific cod, and Atka mackerel as prey species, and foraging behavior (Sections 3.1.2 and 3.1.3).

Table 4.1-8 Criteria for determining significance of effects to cetaceans.

Effects	Score					
	S-	CS-	I	CS+	S+	U
Incidental take/ entanglement in marine debris	Take rate increases by >50%	Take rate increases by 25-50%	Level of take below that which would have an effect on population trajectories	NA	NA	Insufficient information available on take rates
Harvest of prey species	TAC removals of one or more key prey species increased by more than 20%; Deviation of average daily removal rates is >+251	TAC removals of one or more key prey species increased by 5%- 20%; Deviation of average daily removal rates is +100 to +250	TAC removals of prey species equivalent to 1998 harvests (within 5% + or -); Deviation of average daily removal rates is ± 100	TAC removals of one or more key prey species reduced by 5%-20%; Deviation of average daily removal rates is -100 to -250	TAC removals of all key prey species (pollock, Pacific cod, Atka mackerel) reduced by more than 20%; Deviation of average daily removal rates is <-251	Insufficient information available on key prey species
Spatial/ temporal concentration of fishery	Much more temporal and spatial concentration in all key areas	Marginally more temporal and spatial concentration than 1998 fisheries	Similar temporal and spatial fishery distribution as in 1998 fisheries	Much less temporal and spatial concentration in some, but not all key areas	Much less temporal and spatial concentration in all key areas	Insufficient information as to what constitutes a key area
Disturbance	Much more disturbance (all closed areas reopened)	Marginally more disturbance (some closed areas reopened)	Similar level of disturbance as that which was occurring in 1998	NA	NA	Insufficient information as to what constitutes disturbance

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown

NA = Not Applicable

TAC = Total Allowable Catch

Percentages used in determining the significance of effects are given as a plausible point of departure to initiate discussion as opposed to being deemed statistically meaningful per se. Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtedly zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. A similar interpretation of significance has been made for disturbance effects on marine mammals. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant (4.1.2.1), the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to these analyses.

Table 4.1-9 Summary of effects of Alternatives 1 through 5 on ESA listed cetaceans.

ESA Listed Cetaceans	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

In all cases, the direct and indirect effects are expected to have insignificant effects on listed great whales (Table 4.1-9). There was some consideration that reduced harvests may be beneficial to humpback whales by reducing incidental takes under Alternatives 2, 3, and 5, which close certain areas to fishing, but that would assume that the incidental takes that are occurring are affecting only the smaller western North Pacific stock of humpback whales. Identifying mortalities to stock (i.e., conducting genetic tests on biopsy samples and/or photo-identification) would resolve whether takes are occurring in the western stock or in the central stock. The effects of incidental take on the central stock would be insignificant at the population level given current estimates of abundance (about 4,000 whales) and that the stock appears to be increasing (Angliss *et al.*, 2001). However the potential for reducing takes of humpback whales from a level which has been deemed insignificant in 1998, while desirable, is still rated insignificant (Table 4.1-7).

Re-initiation of Consultation under Section 7 of the ESA is unnecessary

Effects were evaluated to determine if a need to reinitiate formal consultation, pursuant to Section 7 of the ESA would be necessary as a result of any of the alternatives. None of the alternatives are expected to negatively effect ESA listed cetaceans by an increase in incidental take. Critical habitat has not been designated for ESA listed cetaceans. In addition, no new information has become available since or alternative actions modified in a manner not previously considered by the NMFS (2000a) Biological Opinion that would be expected to change the conclusion that no adverse effect to ESA listed cetaceans will result from any of the alternatives. Consequently, re-initiation of ESA Section 7 consultation is not necessary for ESA listed cetaceans.

4.1.3 Effects on Other Cetaceans Besides ESA Listed Species

Ten species of whales and dolphins occur in Alaskan waters and are protected under the MMPA (but not listed under the ESA) including: the gray whale, minke whale, beluga whale, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall's porpoise and beaked whales (Baird's, Cuvier's and Stejneger's). Each proposed alternative will be discussed in terms of four potential effects on these cetaceans: 1) direct (or incidental) take/entanglement in marine debris, 2) harvest of prey species, 3) temporal/spatial concentration of the fishery, and 4) disturbance. To date, direct interactions with groundfish fishery vessels have been documented between 1989 and 2000 for five of the ten species: minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall's porpoise. Several cases of entanglements in marine debris also have been reported for gray whales. Five of the ten species listed consume groundfish as part of their diet:

minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall's porpoise. Discussions of effects will focus principally on these species.

The criteria for determining significance of effect in this and other cetacean species groups presented in Table 4.1-8.

Direct (or Incidental) Take/Entanglement in Marine Debris

Direct mortalities of five species from entanglement in fishing gear have been observed and reported in the groundfish fishery since 1989. The criteria for determining significance of incidental take (Table 4.1-6) were applied to evaluate level of take for each alternative. Total allowable catch was used to project incidental take within each fishery (Table 4.1-2). A rating of insignificant is, therefore, a take rate that is below that which would have an effect on population trajectories. A rating of conditionally significant negative is a take rate that increases by 25% to 50% the average annual incidental take for the years 1996-2000. A rating of significantly negative is a take rate that increases by more than 50% the average annual incidental take for the years 1996-2000. Increasing take rate significance ratings in increments of 25% are coupled more with scientific uncertainty about knowledge of the actual take rate more than indicating progressively negative degrees of significance (Table 4.1-8). Incidental takes attributed to the fisheries and entanglement in fishing gear and marine debris occur at low levels thought to be insignificant to marine mammal populations. The ideal level is undoubtedly zero, however even a reduction to zero is considered to be insignificant to marine mammal populations. Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis. Closures to fishing areas were also considered when evaluating this effect by comparing the portion of takes that occurred within proposed closed areas to total incidental take for the fishery from 1989-1999.

A single minke whale mortality was reported in the BS/GOA joint-venture trawl fishery (predecessor of the current fishery) in 1989. Ten years later, a single minke whale mortality was reported in the BS pollock trawl fishery operating in the eastern Bering Sea in autumn 1999. Minke whales are reported in this region year-round, most often in the summer (POP, 1997). Killer whale mortalities are second only to Dall's porpoise in the groundfish fishery. The majority of takes reported between 1989 and 1999 occurred in the BS trawl fishery (8 deaths) followed by the BS longline (2 deaths) and GOA longline (1 death) fisheries. Two mortalities of Pacific white-sided dolphins have been reported in the EBS pollock groundfish fishery. One in the trawl fishery in the spring of 1992, the other in the longline fishery during the winter of 1995. These dolphins are present in Alaska waters year-round although sightings are reported with greater frequency during the summer (POP, 1997). Four harbor porpoise mortalities were reported in the EBS trawl fishery between 1994 and 1997. Although harbor porpoise occur year-round in coastal and shelf waters of the AI, BS and GOA, mortalities occurred in all seasons except winter. The highest incidental take rate for any cetacean is that of Dall's porpoise. Most mortalities reported between 1989 and 2000 occurred in the BS trawl fishery (1 injury and 45 deaths) followed by the BS longline (3 deaths), GOA trawl (3 deaths), and BS jig (1 injury) fisheries. The extent of interactions between gray whales and the groundfish fishery are not known. Rope entanglement injuries and deaths as well as ship-strike injuries appear to be rare. Since 1997, five entanglements (mostly in pot gear) and one ship strike mortality have been reported in Alaska waters.

Harvest of Prey Species

One or more of the target species (pollock, Atka mackerel and Pacific cod) of the GOA and BSAI groundfish fisheries have been identified as prey species of minke whales, killer whales, Pacific white-sided dolphins, harbor porpoise, and Dall's porpoise. To evaluate changes to the harvest of prey for each alternative, significance criteria were developed to span TAC removals ranging from more than 5% to 20% compared to projected TAC for Alternative 1. Therefore, where removals of one or more key prey species of cetaceans remains the same (within $\pm 5\%$) as that proposed in past TACs, a rating of insignificant is given. Decreasing and increasing removals of prey species (Table 4.1-1) result in significance ratings that are progressively positive and negative, respectively (Table 4.1-8). Sizes of prey species consumed by cetaceans, where available, were also considered when evaluating this effect.

Prey preferences of eastern North Pacific minke whales are not known but may be inferred from western North Pacific studies (Kasamatsu and Tanaka, 1992; Tamura *et al.*, 1998). Pelagic schooling fishes (in particular herring, walleye pollock, mackerel, anchovy, and saury) make up over 90% of the total prey weight ingested. Other important prey include sand lance, capelin, saffron cod, Arctic cod, crustaceans, and small quantities of squid. The stomach of a minke whale stranded in the Aleutian Islands contained walleye pollock ranging in size from 4.6 to 6.8 in. (11.8 to 17.5 cm), on the low end of the size range targeted by the fisheries: 5.8-19.5 in (15-50 cm). Killer whales consume a wide variety of prey including fish, birds and other marine mammals (Jefferson *et al.*, 1991). Walleye pollock has not been identified as prey of killer whales, however, the ranges of these species overlap in areas where both are abundant. Atka mackerel were consumed by killer whales caught in the coastal waters off Japan, but importance of the species to killer whales was unknown (Yang, 1999). Where interactions with experimental longline groundfish fisheries have been observed, killer whales preyed upon sablefish, Greenland turbot, arrowtooth flounder and Pacific halibut while ignoring other species of fish available to them such as Pacific cod, grenadier, rockfish, walleye pollock, and shortspine thornyhead (Yano and Dahlheim, 1995). Pacific white-sided dolphin prey varies relative to sampling location. In pelagic populations in the north Pacific and off the coast of northern Japan, fish prey included lanternfish, deep-sea smelt, and *Argentina* sp., and squid (Walker and Jones, 1993). In coastal regions, preferred prey include northern anchovy, Pacific hake, Pacific herring, capelin and squid, and to a lesser extent, pollock, rockfish, mackerel, smelt, saury, eulachon, and sanddab (Walker *et al.*, 1986; Morton, 2000). Harbor porpoise prey studies have not been conducted in Alaska. However, prey studies in Washington and British Columbia found their diet included cephalopods and a wide variety of fish, including Pacific herring, smelt, eelpout, eulachon, pollock, Pacific sand lance, and gadids (Gearin *et al.*, 1994; Walker *et al.*, 1998). Most porpoise appeared to feed on juvenile, possibly even larval gadids (e.g., tomcod and hake) as estimated by the relative size of otoliths. The diet of Dall's porpoise in Alaska waters is principally cephalopods and fish (including Pacific herring, salmon, capelin, deep-sea smelt, lanternfish, walleye pollock, Arctic cod, eelpout, Pacific sand lance, rockfish, sablefish, Atka mackerel, and flatfish). Commercially important fish species were present in only small amount in animals taken in the North Pacific Ocean (e.g., pollock only occurred in 8 of 272 stomachs examined) (Crawford, 1981). Walleye pollock ranged in size from 1.6 to 5.8 in. (4-15 cm), on the low end of the size range targeted by the fisheries: 5.8-19.5 in (15-50 cm).

Temporal/Spatial Concentration of Fishery

Proposed changes to the fishery include area closures, season closures, and seasonal allocations of TAC. Temporal and spatial concentration criteria qualitatively score the fishery. A rating of insignificant indicates the same temporal and spatial distribution of the fishery, while "marginally" less or more temporal or spatial concentration of the fisheries yields a rating of conditionally significant positive or negative, respectively,

and “much” less or more yields a rating of significantly positive or negative, respectively. For those species where prey competition is not evident or changes in TAC are not greater than $\pm 5\%$ under an alternative, increases or decreases in concentrations of fish removals will have an insignificant effect. However, area and season closures may benefit these species by reducing incidental interactions and disturbance.

Disturbance

The effects of disturbance caused by vessel traffic, fishing operations, or underwater noise associated with these activities on baleen (gray and minke whales) and toothed (beluga, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall’s porpoise and beaked whales) whales in the GOA and BSAI are largely unknown. Migrating gray whales sometimes exhale underwater, expose their blowholes only to inhale (termed “snorkeling”), and change course when disturbed by vessels (reviewed in Richardson *et al.*, 1995). Conversely, gray whales will sometimes approach idling or slow moving vessels. Similarly, minke whales generally do not approach and sometimes avoid vessels that are underway (Palka and Hammond, 2001), but may swim toward and under stationary or slow-moving vessels (Leatherwood *et al.*, 1982; Tillman and Donovan, 1986). Reactions by belugas to vessels largely depends on boat type and operation, and whale activity and experience. These whales abandoned summering areas only for short periods when disturbed (even when the disturbance was hunting boats) and at times would interact with vessels (reviewed in Richardson *et al.*, 1995). Killer whales, Pacific white-sided dolphins, Dall’s porpoise and beaked whales sometimes accompany vessels for extended periods of time. In some cases, vessel attraction was so intense that it comprised estimates of abundance for Pacific white-sided dolphins (Buckland *et al.*, 1993) and Dall’s porpoise (Turnock and Quinn, 1991). Conversely, harbor porpoise tend to avoid vessels (Taylor and Dawson, 1984; Palka and Hammond, 2001). Reaction to gear, such as pelagic trawls is unknown, although the rarity of incidental takes suggests either partitioning or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary.

Vessel noise and the routine use of various sonar devices are audible to whales and may be disturbance sources. Calling behavior in gray whales changed to reduce masking by boat noise (Dahlheim 1987). Higher-frequency motor noise was found to mask minke whale sounds (reviewed in Richardson *et al.*, 1995). High-frequency components of vessel noise were found to modify pod integrity, surfacing and diving behavior, and call types of belugas (Cosens and Dueck 1993), while propeller cavitation noise from icebreakers was predicted to mask beluga calls within 8-38 nm (14-71 km) of the ship (Erbe and Farmer, 2000). Most shipping noise is below the hearing thresholds of the smaller odontocetes (sensitivity is usually above 10 kHz: Dotinga and Oude Elferink, 2000), and for most cetaceans, repeated exposure to sound sources led to habituation (Richardson *et al.*, 1995).

Bottom trawls on the eastern Bering Sea shelf operate during the summer when most of the eastern North Pacific stock of gray whales forages in that area. The question then arises, does the bottom trawling activity affect the availability of benthic prey, an important food source for gray whales? The criteria used to describe the disturbance effects of the alternative are qualitative. A rating of insignificant indicates the same level of disturbance, while “marginally” more disturbance results in a rating of conditionally significant negative, and “much” more results in a rating of significantly negative. Given that the level of disturbance established for management measures comparable those in effect for 1998 were deemed insignificant (citation ?), the additional management measures contained in Alternatives 2 through 5 which could result in even less disturbance than that which is insignificant is also deemed insignificant to marine mammal populations.

Therefore NMFS considers effect ratings of conditionally significant positive and significantly positive as not applicable to this analysis.

4.1.3.1 Effects of Alternative 1 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Minke whale mortalities may have been the result of prey competition (see Harvest of Prey Species below) because these whales appear to avoid vessels in northern waters (Palka and Hammond, 2001), though this behavior has not been reported in Alaska waters. Under Alternative 1, the take rate for the pollock fishery would not change greater than $\pm 25\%$, therefore, the intensity is rated insignificant. Area closures to pollock and trawl fishing do not apply to the region where the mortality occurred in 1999. Population level effects are uncertain because abundance estimates are available for only a small part of this stocks range and "home ranges" have not been determined. However, takes have been reported infrequently (once every ten years), therefore, the effect of take on minke whales is insignificant.

Incidental take rates of all marine mammals relative to TAC for the BS fishery (pollock, Pacific cod, and Atka mackerel) (Table 4.1-2) do not change by more than -5%, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)) under Alternative 1. For killer whales, fishery interactions, at least with longline vessels, appear to be a function of attraction to the vessel in order to consume non-target species rather than direct prey competition. Population level effects are uncertain because it is unknown whether this behavior is pod specific, in which case one mortality per year could potentially diminish pod viability. For these reasons the effect on killer whales of Alternative 1, and all other alternatives considered, is unknown (Table 4.1-10). The effect of take on Pacific white-sided dolphins is insignificant. Although population level effects are uncertain because abundance estimates are not available for the Bering Sea, takes have been reported only two times in the past 10 years. Because harbor porpoise in northern waters appear to avoid vessels (Taylor and Dawson, 1984; Palka and Hammond, 2001), mortalities may have been the result of prey competition (see Harvest of Prey Species below). However, current abundance estimates show even if prey competition is occurring, population level effects would be insignificant. Vessel attraction behavior rather than prey competition appears to be a factor in interactions between the fisheries and Dall's porpoise. Overestimates of abundance of this stock may be as high as fivefold because of vessel attraction behavior (Turnock and Quinn, 1991). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. The extent of interactions between gray whales and the groundfish fishery are not known, however, population level effects would be insignificant given the current increasing trend in abundance of eastern North Pacific gray whales and recovery of this stock from endangered status under the ESA.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the Pollock TAC are not greater than $\pm 5\%$, so the intensity of the effect is rated insignificant under Alternative 1. Pollock consumed by these species are usually smaller (larval and juvenile fish) than those targeted by the fishery. As described in section 4.1.1.1 and elsewhere, the deviation difference for mean daily removal rates of the overall pollock fishery is -59 (Table 4.1-3), and insignificant effect (Table 4.1-9).

Where interactions with experimental longline groundfish fisheries have been observed, killer whales preyed upon sablefish, Greenland turbot, arrowtooth flounder and Pacific halibut while ignoring other species of fish available to them such as Pacific cod, grenadier, rockfish, walleye pollock, and shortspine thornyhead

(Yano and Dahlheim, 1995). Fishery interactions in this case appear to be more a function of attraction to fishery vessels in order to consume non-target species rather than direct prey competition. Assuming sablefish, turbot, flounder, and halibut are key prey, bycatch of these species in the groundfish fisheries do not exceed 5% of the total catch (NMFS unpublished observer data). Therefore, the intensity of this effect is rated insignificant for killer whales (same removals of one or more key prey species ($\pm 5\%$)).

Key prey species of Pacific white-sided dolphins and Dall's porpoise include cephalopods and small schooling fishes. Fishery interactions in the case of Dall's porpoise may be more a function of attraction to vessels rather than direct prey competition. Bycatch of these fish species do not exceed 1% of the total catch (NMFS unpublished observer data). The intensity of this effect is rated insignificant under Alternative 1 (same removals of one or more key prey species ($\pm 5\%$)).

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

Prey competition is not evident or changes in TAC are not greater than $\pm 5\%$ for killer whales, Pacific white-sided dolphins, and Dall's porpoise, therefore, temporal and spatial concentration of fish removals will have an insignificant effect. For minke whales and harbor porpoise, where prey competition may be occurring and TAC does change, the extent of prey overlap may be low because these cetaceans appear to be consuming mostly larval and juvenile fish while the fishery is targeting adults. Therefore, any increase or decrease in concentrations of prey removed would not necessarily effect these species at a population level. The intensity of this effect is rated insignificant under Alternative 1.

Indirect Effects - Disturbance Effects (Question 4)

Given the continued occupation of the fishing grounds by these animals, disturbance from vessels and sonar, if it occurs in the BSAI or GOA, does not appear to have population level effects though it may disrupt communication temporarily. The relationship between gray whales and bottom trawling is unclear, although population level impacts do not appear to have occurred in light of this stocks having nearly fully recovered (Rugh *et al.*, 1999) coincident with decades of bottom trawling on the eastern Bering Sea shelf. The intensity of this effect is rated insignificant (same level of disturbance) under Alternative 1.

4.1.3.2 Effects of Alternative 2 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is -13% under Alternative 2, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). However, under this alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 73% occurred in areas proposed for closure. For Dall's porpoise, roughly 45% of deaths that occurred between 1989 and 1999 (24 out of 53) occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 2 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations where minke whale and Pacific white-sided dolphin mortalities took place. Harbor porpoise mortalities would be reduced by half (from 4 to 2 deaths) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 2. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than $\pm 5\%$. However, the AI Pollock Fishery TAC and the GOA Pollock Fishery TAC would be reduced by 92% and 54%, respectively, under Alternative 2. The result is a 7% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect may be beneficial for minke whales under Alternative 2 (5%-20% reduction in TAC of one or more key prey species). It is not known if minke whales are exclusively consuming pollock within these fishery management zones or if these areas constitute "home ranges" for this whale stock. However, minke whales appear to be consuming pollock that are smaller than that targeted by the fishery therefore the effect on minke whales under Alternative 2 is rated insignificant. For harbor porpoise, population level effects are considered insignificant given their current abundance in the GOA and BS and that they appear to consume larval and juvenile fish not targeted by the fishery.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 2.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 2.

4.1.3.3 Effects of Alternative 3 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) do not change under Alternative 3, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). However, under this Alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 55% occurred in areas proposed for closure. For Dall's porpoise, roughly 28% of deaths that occurred between 1989 and 1999 occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 3 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations of minke whale and Pacific white-sided dolphin mortalities. Harbor porpoise mortalities would be reduced by half (from 4 deaths to 1) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 3. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than $\pm 5\%$, and as described in section 4.1.1.1 and elsewhere, the deviation difference of relative mean daily removal rate is -36 (I). However, the GOA Pollock Fishery TAC would be reduced by 15% under Alternative 3. The result is a 1% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4), though on a daily removals basis this is insignificant (-27, Table 4.1-3). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect is rated insignificant (same removals of one or more key prey species [$\pm 5\%$]) for minke whales and harbor porpoise under Alternative 3.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 3.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 3.

4.1.3.4 Effects of Alternative 4 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4 except for killer whales which is unknown (Table 4.1-10).

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 4.

4.1.3.5 Effects of Alternative 5 on Other Cetaceans Besides ESA Listed Species

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates of all marine mammals relative to TAC for all fisheries combined (Table 4.1-2) is +3% under Alternative 5, therefore, the intensity of this effect is rated insignificant (take rate is similar ($\pm 25\%$)). However, under this alternative, closure areas may reduce some of the incidental takes of killer whales and Dall's porpoise in the BSAI fisheries. Of the 11 killer whale deaths reported, 36% occurred in areas proposed for closure. For Dall's porpoise, roughly 11% of deaths that occurred between 1989 and 1999 occurred within areas slated for closure. However, if killer whales and Dall's porpoise are attracted to vessels they may follow the fishery outside these areas. The significance of this effect may be beneficial for killer whales because it is not known whether this behavior is pod specific and occurring only within those areas proposed for closure. Overall, the effect on killer whales under Alternative 3 is unknown (Table 4.1-10). The effects of incidental take on Dall's porpoise would be insignificant at the population level given current estimates of abundance. These closure areas do not extend to the locations of minke whale and Pacific white-sided dolphin mortalities. Harbor porpoise mortalities would be reduced by half (from 4 deaths to 1) but the effects of take would be insignificant at the population level given current estimates of abundance.

Direct Effects - Fisheries Harvest of Prey Species (Question 2)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for killer whales, Pacific white-sided dolphins, and Dall's porpoise under Alternative 5. Assuming pollock are a key prey species of minke whales and harbor porpoise, changes proposed for the EBS Pollock TAC are not greater than $\pm 5\%$. However, the AI Pollock Fishery TAC would be reduced by 92% under Alternative 5. The result is a 1% reduction in TAC for all pollock fisheries combined (calculated from Table 4.1-4). Bycatch summaries for the other prey species listed do not exceed 1% of total catch. The intensity of this effect is rated insignificant (same removals of one or more key prey species ($\pm 5\%$)) for minke whales and harbor porpoise under Alternative 5.

Indirect Effects - Spatial and Temporal Concentration of Fishery (Question 3)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 5.

Indirect Effects - Disturbance Effects (Question 4)

For the same reasons listed under Alternative 1, the intensity of this effect is rated insignificant for all cetaceans under Alternative 5.

4.1.3.6 Summary of Effects on Other Cetaceans Besides ESA Listed Species

The criteria for determining significance of effect in this and other cetacean species groups presented in Table 4.1-8.

Table 4.1-10 Summary of effects of Alternatives 1 through 5 on other cetaceans besides the ESA listed species.

Unlisted cetaceans	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)	I (U for killer whales)
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

In all cases, the direct and indirect effects are expected to have insignificant effects on cetaceans (Tables 4.1-7, 4.1-9). The case that differs is the effects of incidental take on killer whales which are unknown for all alternatives. The consideration that the effect may be beneficial for alternatives that close certain areas to fishing assumes that the incidental takes would occur within the same pods and thus affect pod viability. Identifying mortalities to pod, and conducting photo-identification studies of killer whales associating with fishing vessels, would resolve whether takes are occurring in only one pod or from many pods. However the potential for reducing takes of killers whales is unknown.

4.1.4 Effects of the Alternatives on Northern Fur Seals

As with other apex predators such as Steller sea lions, ecological interactions between northern fur seals and the groundfish fisheries are caused by spatial and temporal overlap between fur seal foraging areas and groundfish fisheries and from competition for target and bycatch species taken by the fisheries. The diet of northern fur seals includes a wide range of fish species, with less apparent dependence on Pacific cod and Atka mackerel compared to Steller sea lions (Section 3.4). However, both adult and juvenile pollock occur in the diet of northern fur seals and consumption rates vary according to the abundance of different age classes of pollock in the foraging environment (Swartzman and Haar, 1983; Sinclair *et al.*, 1996). Evaluation of the indirect effects of fisheries on northern fur seals, stemming from the various alternatives, therefore, focuses less on removals of Pacific cod and Atka mackerel and more broadly on removals of pollock and small schooling fishes.

Northern fur seals forage at shallow to mid-water depths of 0 to 820 ft (0-250 m), both near shore and in pelagic regions of their migratory range. Female and young male fur seals generally consume juvenile and small-sized (2 to 8 inch) schooling fishes and squids although diet varies across oceanographic subregions along their migration routes and around breeding locations in the Pribilof Islands. In the eastern Bering Sea, primary prey species include pollock and Pacific cod, but deep sea smelts, lanternfish, and squids are also major components. Recent studies based on scat analysis have indicated that the pollock and Pacific cod

consumed by fur seals tend to be smaller than those selected by the target fisheries, however data from stomach collections from the 1960s through the 1980s indicate that fur seals often consume adult pollock. Recent studies used bio-chemical methods to study the diet of northern fur seals suggests that the diet of deep diving fur seals in waters over the continental shelf includes adult pollock (Kurle and Worthy, 2000; Goebel, 2001). Thus, the most relevant indirect effects of the alternatives on northern fur seals are likely to be those that either increase or decrease the abundance or distribution of smaller schooling fishes and squid, or shift the overall pattern of pollock and Pacific cod harvest in a manner that changes the harvest rate of fur seal prey.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on northern fur seals is outlined in Table 4.1-1.

4.1.4.1 Effects of Alternative 1 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals is uncommon in the groundfish fisheries. The last recorded mortality in any Alaskan groundfish fishery occurred in 1996, when the take rate was one animal per 1,862,573 mt of groundfish harvested. Observer records from 1990 to 1999 indicate that direct interactions with groundfish vessels occurred only in the BSAI trawl fishery, despite observer placement in pot, longline and trawl fisheries in both the BSAI and GOA. In the BSAI trawl fishery, the average annual take rate (1994 to 1998) was 1.4. This level of take contributes little to the northern fur seal potential biological take (PBR) of 18,244 (Ferrero *et al.*, 2000) and is inconsequential to population trends.

Northern fur seal entanglement in marine debris is more common than any other species of marine mammal in Alaskan waters (Laist, 1987, 1997; Fowler, 1987). Fowler (1987) concluded that mortality of northern fur seals from entanglement in marine debris contributed significantly to declining trends in the Pribilof Islands during mid to late 1970s and early 1980s. Laist (1997) suggested that modest signs of northern fur seal population recovery in recent years may be an indication that entanglement in net debris is among the factors impeding population recovery. As noted earlier in Section 4.1.1 Annex V of the MARPOL statute prohibits the discard of plastics, including net debris. The contribution of intentional discard of net debris from Alaskan groundfish fisheries vessels is thought to have declined over the past decade. However, consistent numbers of seals entangled in packing bands on St. Paul Island may reflect disposal of these materials in proximity to the islands. Recent data from satellite-tracked drifters deployed in the Bering Sea suggests a “trapped” circulation pattern around the Pribilof Islands (Stabeno *et al.*, 1999) which may retain marine debris in the nearshore environment. An increase in the number of Antarctic fur seals (*Arctocephalus gazella*) entangled in polypropylene packing bands was observed at Bird Island, South Georgia, in the late 1980s as these materials came into common usage by at-sea processing vessels (Croxall *et al.*, 1990).

Involuntary sources of marine debris, as in loss of gear, are diminishing as fishery cooperative systems develop (such as in the BSAI offshore pollock allocation). That is, as the pace of fisheries is slowed, there is less incentive to risk capital equipment.¹⁶ Data do not yet exist to assess the rates at which various gear types are lost or discarded to result in risk to fur seals, especially in regard to fishery or nation of origin. In

¹⁶Jim Coe, “Personal Communication,” AFSC, 7600 Sand Point Way NE, Seattle, WA 98115.

consideration of progress in stemming the loss and discard of net fragments and other plastic debris by domestic commercial fisheries, the extent to which the current FMP, or any alternatives to it, could change the rate of fur seal entanglement in marine debris is considered to be low. There seem to be few alternatives, given the likelihood that sources beyond the control of fisheries managers (i.e., foreign fisheries, international shipping, and shoreline refuse) constitute significant sources of discard. In view of these factors, the effects on northern fur seals under Alternative 1 are considered insignificant, with respect to incidental take and entanglement in marine debris on northern fur seals.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Management actions under the current BSAI and GOA FMPs, specific to the protection of northern fur seals, have not been addressed directly. Trawl closures around the Pribilof Islands, established mainly for the protection of crab stocks, may offer positive benefits for fur seals by limiting prey removals in waters surrounding the Pribilof Island rookeries. However, only northern fur seals foraging close to the islands would benefit by the availability of an undisturbed prey field and recent tracking studies show that foraging trips of both adult female and juvenile male fur seals extend well beyond the trawl closure boundaries. Furthermore, the partitioning of foraging habitat by lactating fur seals on the Pribilof Islands (Figure 3.1.4-1) indicates that the Pribilof Islands Area Habitat Conservation Zone would primarily benefit females from northeast St. Paul Island and provide less protection to the foraging habitat of females from southwest St. Paul Island or St. George Island.

The Alternative 1 measures result in the removal of northern fur seal forage. The size of the fish removed and whether the bycatch of squid, small schooling fish, pollock, and Pacific cod are a large fraction of their estimated biomass in the Bering Sea must be considered in determining if the harvest could have significant effects on the population. Catches of squid and small schooling fish (e.g., fish designated in the forage fish assemblage) in the groundfish fisheries of the BSAI and GOA are low, generally less than 1,000 mt per year. While precise biomass estimates for these groups do not exist, the exploitation rate on these groups in the groundfish fisheries is also thought to be very low. For instance, squid biomass in the Bering Sea may be as large as 4 million mt, based on marine mammal food habits, daily ration, and abundance data (Sobolevsky, 1996). Similarly, with respect to small schooling fishes, consumption of capelin in the Gulf of Alaska by arrowtooth flounder alone may be as large as 300,000 mt per year (Livingston, 1994). Assuming that these crude projections of squid and capelin biomass at least approximate the order of magnitude of the true population levels, then the fisheries removals would amount to only a fraction of 1 percent of those populations.

Fisheries for pollock do not target fish younger than 3 years of age (Ianelli *et al.*, 1999; Dorn *et al.*, 1999; Thompson and Dorn, 1999; Thompson and Zenger, 1994; Fritz, 1996). The overall catch of pollock smaller than 30 cm is small, and thought to be only 1 to 4 percent of the number of one- and two-year olds each year in the eastern Bering Sea and GOA (Fritz, 1996). However spatial and temporal patterns in the bycatch of juvenile pollock in the Bering Sea may influence the rate of removals in areas where northern fur seals forage. Exploitation rates of 2-3 year old pollock ranged between 11% and 21% from 1973 to 1979 during the period when the foreign fishery in the eastern Bering Sea operated northwest and west of the Pribilof Islands (Fritz, 1996). Seasonally, the highest bycatch of small pollock occurs during early summer (May-July) when spawning aggregations have dispersed and pollock are generally less segregated by size (Fritz, 1996). Data on the consumption rate of adult pollock by northern fur seals is inconclusive. Analysis of data from stomach collections (e.g., Swartzman and Haar, 1983; Sinclair *et al.*, 1994) indicate that fur seals may consume adult pollock when it is available in the foraging environment, whereas studies based on scat analysis show a diet consisting of primarily of juvenile pollock (e.g. Sinclair *et al.*, 1996; Antonelis *et al.*,

1997). Carbon and nitrogen isotope analysis of fur seal tissues suggests that the diet of lactating females includes prey at trophic levels equivalent to 2 - 4 year-old walleye pollock and small Pacific herring during the fall (Kurlle and Worthy, 2000). Fatty acid analysis of milk samples from lactating fur seals consistently diving to depths greater than 328 ft (100 m) in outer continental shelf waters of the Bering Sea had fatty acid signatures most similar to fatty acid signatures of walleye pollock. In waters over the continental shelf, adult walleye pollock are generally found near the bottom while juvenile pollock are usually concentrated in the surface layer above the thermocline (Bailey, 1989) suggesting that the diet of deep diving fur seals in these areas includes adult pollock.

Therefore, while fisheries do harvest prey of northern fur seals (i.e., pollock and Pacific cod), competition due to the harvest rates of those species may vary depending on the size range consumed by fur seals. The overall catch of juvenile pollock has tended to be low in recent years and the degree to which adult pollock occur in the northern fur seal diet is not certain. While the potential overlap with fisheries may be moderated by these factors, effects on northern fur seals may yet exist, the relevance of which is not reflected by estimates of biomass removals over large geographical areas. However, NMFS considers Alternative 1 to have insignificant effects on northern fur seals, as the case for such effects may be weaker than the case for Steller sea lions.

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The competitive overlap between fisheries for Pacific cod and pollock and northern fur seals is influenced by several factors determining whether removals are concentrated in space or time. First, to the degree that the size of fish targeted by the fishery is greater than that generally eaten by fur seals, competition may vary depending on the availability of smaller prey in foraging areas. Second, under Alternative 1, 45% of the catch from both fisheries occurs during the A season in winter when female and juvenile male fur seals are not commonly found in the areas used by fisheries in the Bering Sea or the GOA. Third, during the summer, fishery harvest rates on adult pollock and Pacific cod in areas used by fur seals are below the annual target rates for the fish stocks as a whole (NMFS, 2000c). For instance, in the eastern Bering Sea west of 170°W, pollock harvest rates in the summer have averaged less than 5% since the early 1980s (environmental assessment for pollock RPAs). Pacific cod harvest rates in the same area and time have been less than 1% since 1996. Fourth, under Alternative 1, the summer pollock fishery in the Bering Sea begins on September 1, which reduces the temporal overlap between the pollock fishery and the fur seal breeding season (June-October). These features of fisheries under Alternative 1 suggest that the intensity of their interactions with northern fur seals may not be as pronounced as it appears to be with Steller sea lions.

While these factors lower the probability of adverse impacts stemming from spatial or temporal concentration of fisheries in northern fur seal foraging areas, changes in harvesting activity and/or concentration of harvesting activity in space and time may differentially impact fur seal foraging habitat at both the population and sub-population level. For example, the proportions of total June-October pollock catch in fur seal foraging habitat (defined as the combined meta-home ranges for females from St. Paul and St. George islands; Figure 3.1.4-1) increased from an average of 40% in 1995-1998 to 69% in 1999-2000 (Figure 4.1-1). The shift in the distribution of fishing effort is due in part to trawl closures to protect Steller sea lion foraging habitat implemented during 1999 and 2000; the proportion of pollock catch in Steller sea lion critical habitat decreased from an average of 44% to 16% in the same period. Increases in the catch of eastern Bering Sea pollock may represent potential increases in competition, because pollock represents 34% to 80% of northern fur seal diet in the Bering Sea. Increased catches of other prey items such as Pacific cod, Atka mackerel, and rockfish may be of less consequence, because they comprise less than 5 % of fur seal diet. From 1995-99 the proportion of the summer pollock catch removed from the meta-home range of lactating fur seals from

St. George Island was consistently higher than the catch in foraging areas used by St. Paul Island females (Figure 4.1-1). The smaller size of the population in conjunction with a higher rate of decline in pup production on St. George Island in recent decades suggests that the impact of the pollock fishery in this area on the foraging habitat of St. George Island females should be considered. Given the uncertainty in the degree to which fur seals compete with the fishery for adult pollock in fur seal foraging areas where spatial and temporal overlap has been identified, it is assumed that conditionally significant negative effects could occur.

Indirect Effects – Disturbance Effects (Question 4)

The potential for disturbance effects caused by vessel traffic, fishing gear, or noise appears limited for northern fur seals. Kajimura (in Johnson *et al.*, 1989) reported no response by fur seals when approached by ship, and NMFS observers on board Japanese driftnet vessels regularly reported fur seals in close proximity to both the gear and fishing vessels (International North Pacific Fisheries Commission [INPFC] reports from the 1980s). Interactions with other types of fishing gear, such as trawl nets, also appear limited based on the rare incidence of takes in groundfish fisheries. Thus, the measures under Alternative 1 are consistent with efforts to avoid these kinds disturbance effects on northern fur seals.

Disturbance effects on northern fur seal prey are difficult to identify. Fisheries in the Bering Sea do occur in areas used by foraging northern fur seals, and their prey are represented as both target species (e.g., pollock) and bycatch species. The same principle for assessing prey disturbance effects as developed for Steller sea lions is, therefore, applied here as well. If harvesting activity or concentration of that harvesting activity in space and time change relative to Alternative 1, then the effects on northern fur seals, if any, may be altered. For example, the proportion of hours trawled in June-October catch in combined fur seal female foraging habitat increased from an average of 40% in 1995-1998 to 65% in 1999-2000 (Figure 4.1-2). The proportion of hours trawled in Steller sea lion critical habitat decreased from an average 58% to 20% in the same period. Similar to the spatial distribution of pollock catch discussed above, the number of hours trawled in the area where lactating fur seals from St. George Island forage was consistently higher in 1995-2000 than the hours trawled in foraging areas used by St. Paul Island females (Figure 4.1-2). The Pribilof Island trawl closure provides some constraints on fishing activity in areas where northern fur seals forage, however as discussed above, habitat partitioning between breeding groups and the distance at which fur seals forage from the islands reduce the effectiveness of the trawl closure. The variability of potential disturbance effects among years and between breeding groups on each island suggests that the intensity of disturbance is not well known and that the disturbance effect under Alternative 1 (and all other alternatives considered) is unknown (Table 4.1-9).

4.1.4.2 Effects of Alternative 2 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 2 is expected to mirror rates under Alternative 1. Mortality in fishing gear would remain a rare event. TAC reductions under Alternative 2 would not have a meaningful effect on the existing low mortality rate of less than 1 northern fur seal per 1.5 million mt of groundfish harvested. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris are not likely to have population level effects, despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 2 is not expected to alter the circumstances existing under

Alternative 1. As such, both alternatives are consistent with the goal of limiting direct effects and such, both alternatives are rated as insignificant (Table 4.1-11).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging habitat, and thus the gross amount of target and bycatch species caught will be lower than under Alternative 1. However, closure of the Steller sea lion Conservation Area will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. Figure 4.1-3 shows the location of trawls in the 2000 C and D season EBS pollock fishery relative to the 1998 B season. Although the overall levels of northern fur seal prey removals classified as bycatch in commercial fisheries are very low, the increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. The bycatch of juvenile pollock is typically highest during the summer season in the outer shelf domain when spawning aggregations are dispersed and adult and juvenile pollock are found in the same areas northwest and west of the Pribilof Islands (Fritz, 1996). Current diet information is not sufficient to assess the degree to which fur seals compete with the fishery for adult pollock, but the intensity of competition will logically increase as more fishing occurs in fur seal foraging areas. While the overall extent that removals of pollock and Pacific cod are reduced under Alternative 2, the probable increase in the fisheries harvest of prey species consumed by northern fur seals in the eastern Bering Sea is rated as insignificant (Table 4.1-11).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Recent satellite telemetry data on the foraging locations of northern fur seals allows for analysis of fur seal foraging locations at finer scales of resolution. While Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and thus resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea, it results in an increase in the harvest rate on these species in areas where fur seals forage. The proportion of total June-October catch in fur seal meta-home ranges increased from 47% in 1998 to 64% in 2000. Relative to Alternative 1 (which represents regulations for the 1998 pollock fishery), this reflects a change in the impact on northern fur seal foraging habitat. Alternative 2 also expands the timing of the fishery from only September and October to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution and may substantially change the level of interactions.

Areas closed to fishing in the eastern Bering Sea under Alternative 2 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Unimak Pass and on the shelf to the east of the Islands in the Pribilof Islands Conservation Area. While catches of fur seal prey will be lower in these areas, Alternative 2 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery relative to Alternative 1. For fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. Given that Alternative 2 differs from Alternative 1 and represents probable increases in the spatial and temporal interactions of the groundfish fisheries with northern fur seals, it is rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 2 is not expected to result in new forms of disturbance however it may intensify those previously discussed under Alternative 1. The critical habitat protections implemented during the 2000 summer fishery in the Bering Sea, resulted in an increase in the number of hours trawled in areas where fur seals forage. Coincident with the increased pollock catch in fur seal foraging habitat resulting from critical habitat protections for Steller sea lions, the proportion of hours trawled during June-October in fur seal meta-home ranges increased from 42% in 1998 to 63% in 2000. Relative to Alternative 1, it is reasonable to assume that the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if similar area closures are implemented under Alternative 2. As with Question 3, the expansion of the timing of the fishery under Alternative 2 from September-October to the entire season when fur seals are breeding on the Pribilof Islands (June - October) will increase the disturbance in fur seal foraging habitat. While this change may slow the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. Although Alternative 2 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect on the disturbance of northern fur seals is unknown (Table 4.1-11).

4.1.4.3 Effects of Alternative 3 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 3 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris is not likely to have population level effects despite the ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 3 is not expected to alter the circumstances existing under Alternative 1. Thus, the effects relating to direct takes and entanglement in derelict fishing gear under Alternative 3 is rated insignificant (Table 4.1-11). Alternative 3 is consistent with the underlying protection goal with reference to limiting direct effects.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The percentage of the TAC occurring during the C/D seasons will increase to 60% from 55% during the B season under Alternative 1. The increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat described under Alternative 2 will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. In addition, the shift in the beginning of the fishery from September 1 to June 1 will increase competition during the fur seal breeding season. The bycatch of juvenile pollock is typically highest during the summer season in the outer shelf domain when spawning aggregations are dispersed and adult and juvenile pollock are found in the same areas northwest and west of the Pribilof Islands (Fritz, 1996). Current diet information is not sufficient to assess the degree to which fur seals compete with the fishery for adult pollock, however both recent fatty acid and stable isotope analyses of fur seal diets in addition to historical data based on stomach sampling indicate that fur seals consume adult pollock. The intensity of competition will logically increase as more fishing occurs in fur seal foraging areas. However, the magnitude of the competition is not expected to have population level effects and Alternative 3 is rated as insignificant (Table 4.1-9).

Indirect Effects – Spatial and Temporal Concentration on Fishery (Question 3)

Alternative 3 also reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and with the exception of opening Area 7 to fishing, resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea. In 2000, the shift in fishing effort relative to the 1998 fishery caused an increase the harvest rate on prey species in areas where fur seals forage. As stated above, the proportion of total June-October catch in fur seal meta-home ranges increased from 47% in 1998 to 64% in 2000, indicating a possible change in the impact on northern fur seal foraging habitat under Alternative 3. Increased temporal overlap may also occur as the timing of the fishery changes from only September and October to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution.

As discussed under Alternative 2, areas closed to fishing in the eastern Bering Sea under Alternative 3 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Unimak Pass in the CVOA and SSL Conservation Area and in the Pribilof Islands Conservation Area, as well as 20 nm closures around the Pribilof islands. While catches of fur seal prey will be lower in these areas, Alternative 3 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery relative to Alternative 1. For fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. Given that Alternative 3 will likely increase in the spatial and temporal interactions of the groundfish fisheries with northern fur seals relative to Alternative 1, it was rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The spatial and temporal overlap of the fishery and northern fur seal foraging habitat resulting from the closure of Area 8 in the CVOA and Area 7 in the SSL Conservation Area under Alternative 3 will result in an increase in the number of hours trawled in areas where fur seals forage. Relative to Alternative 1, it is reasonable to assume that the level the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if area closures are implemented under Alternative 3. Similar to Question 3, the expansion of the timing of the fishery under Alternative 2 from September-October to the entire season when fur seals are breeding on the Pribilof Islands (June -October) will increase the duration of the disturbance in fur seal foraging habitat. Although Alternative 3 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect is unknown (Table 4.1-11).

4.1.4.4 Effects of Alternative 4 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 4 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris is not likely to have population level effects despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 4 is not

expected to alter the circumstances existing under Alternative 1. Thus, the effects related to direct takes and entanglement in derelict fishing gear under Alternative 4 are insignificant (Table 4.1-11). The alternative is consistent with the underlying protection goal with reference to limiting direct effects.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 4 represents little change in the harvest of fur seal prey species relative to Alternative 1. Under Alternative 4 increased competition for prey species in fur seal foraging habitat will occur from the seasonal shift in the timing of the fishery (September and October under Alternative 1 to June -October under Alternative 4). The division of the Alternative 1 fall fishery into two seasons with equal allocations will likely slow the pace of the fishery, thus reducing the intensity of competition. However, seasonally, the highest bycatch of small pollock occurs during early summer (May-July) when spawning aggregations have dispersed and pollock are generally less segregated by size (Fritz, 1996). However, the magnitude of increased bycatch of fur seal prey species during the breeding season due temporal shifts in catch distribution is not expected to effect the fur seal population as a whole, Alternative 4 is rated as insignificant (Table 4.1-11).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Under Alternative 4 only the Sea Lion Conservation Area will be closed to trawling for pollock and catcher-processors will be excluded from the CVOA from June 10 to December 31. This will shift the spatial distribution of the fishery into fur seal foraging habitat to some degree, however it is difficult to predict whether increased competition will occur due to the harvest of prey species. From 1999 to 2000 the pollock catch occurring in the foraging habitat of St. George Island females dropped from 44.7% to 28.4%, while fishing in the foraging area of northeast St. Paul increased from 21% to 34% during the same period (Figure 4.1-1). The shift in fishing distribution reflects the closure of Areas 7 and 8 during the 2000 pollock fishery and illustrates the potential for varying degrees of competition between the foraging areas of fur seals from each island. As with Alternatives 2,3 and 5, Alternative 4 expands the timing of the fishery from only September and October (Alternative 1) to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects between foraging areas. Given the uncertainty of the effect of increased fishing in fur seal habitat during June-August, the effects of Alternative 4 are rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The disturbance effects under Alternative 4 mirror the possible effects resulting from the spatial and temporal concentration of the fishery discussed in the previous section. Figure 4.1-2 shows the decrease of 13.6% in hours trawled in the foraging area of St. George Island females from 1999 to 2000 while hours trawled in the foraging area of northeast St. Paul increased 19% during the same period. Given the uncertainty regarding the potential disturbance to the fur seal prey field of increased fishing in fur seal habitat during June-August, in addition to variability in the effects of on different foraging areas, the effects on the disturbance of northern fur seals under Alternative 4 is unknown (Table 4.1-11).

4.1.4.5 Effects of Alternative 5 on Northern Fur Seals

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of northern fur seals in the groundfish fisheries under Alternative 5 is expected to mirror rates under Alternative 1. The anticipated changes in harvest rates or fisheries distributions would not affect the very low rate of northern fur seal incidental take. Mortality in fishing gear would remain a rare event. As noted in Section 4.1.4.1, domestic fisheries contributions to northern fur seal entanglement in discarded net debris are not likely to have population level effects despite ongoing debate about the effects of marine debris from all sources, including those beyond the control of fisheries management. Alternative 5 is not expected to alter the circumstances existing under Alternative 1. Thus, the effects relating to direct takes and entanglement in derelict fishing gear are rated insignificant (Table 4.1-9). Alternative 4 is consistent with the underlying protection goal with reference to limiting direct effects.

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 5 is derived from the suite of RPA measures that were in place for the 2000 pollock and Atka mackerel fisheries. It limits the amount of catch within Steller sea lion critical habitat to be in proportion to estimated fish biomass. To the extent that fishing effort is displaced from the Steller sea lion Conservation Area, Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The probable effect is indicated by the location of trawls in the 2000 C and D season EBS pollock fishery relative to fishery relative to the 1998 B season (Figure 4.1-3). Although the overall levels of northern fur seal prey removals classified as bycatch in commercial fisheries are very low, the increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. As with Alternatives 2-4, Alternative 5 also expands the timing of the fishery from only September and October to June-October when fur seals are breeding on the Pribilof Islands and the bycatch of juvenile pollock is typically highest in the outer shelf domain (Fritz, 1996). Similarly, to the degree to which fur seals compete with the fishery for adult pollock, the intensity of competition will may increase as more fishing occurs in fur seal foraging areas. However, the magnitude of the competition is not expected to have population level effects and Alternative 3 is rated as insignificant (Table 4.1-9).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The implementation of the RPA measures during the 2000 summer fishery in the Bering Sea, increased the proportion of total June-October catch in fur seal meta-home ranges from 47% in 1998 to 64% in 2000. Relative to Alternative 1 (which represents regulations for the 1998 pollock fishery), this reflects a change in the impact on northern fur seal foraging habitat. Alternative 5 also expands the timing of the fishery from only September and October to cover the entire season when fur seals are breeding on the Pribilof Islands (June -October). Alternative 5 allows fishing in critical habitat in proportion to the estimated fish biomass and may result in less overlap outside of areas closed to fishing. As discussed above, for fur seals, this effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. However, given that Alternative 5 differs from Alternative 1 representing probable increases in the spatial and temporal interactions of the groundfish fisheries with northern fur seals, it is rated as conditionally significant negative (Table 4.1-11).

Indirect Effects – Disturbance Effects (Question 4)

The RPA measures implemented during the 2000 summer fishery in the Bering Sea, resulted in an increase in the number of hours trawled in areas where fur seals forage. The increased pollock catch in fur seal foraging habitat resulting from RPA measures implemented to protect Steller sea lion habitat resulted in an increase in the proportion of hours trawled during June-October in fur seal meta-home ranges from 42% in 1998 to 63% in 2000. Relative to Alternative 1, it is reasonable to assume that the level the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if similar area closures are implemented under Alternative 5. As discussed for Alternatives 2-4, changes in the timing of the fishery under Alternative 5 will increase the period of disturbance in fur seal foraging habitat to cover the entire breeding season (June-October). Although Alternative 5 may increase the disturbance to the fur seal prey field relative to Alternative 1, its effect is unknown (Table 4.1-11).

4.1.4.6 Summary of Effects on Northern Fur Seals

The criteria used for determining the significance of effects on northern fur seals under Alternatives 1 through 5 is outlined in Table 4.1-1. Table 4.1-11 summarizes the effects under Alternatives 1 through 5 on northern fur seals.

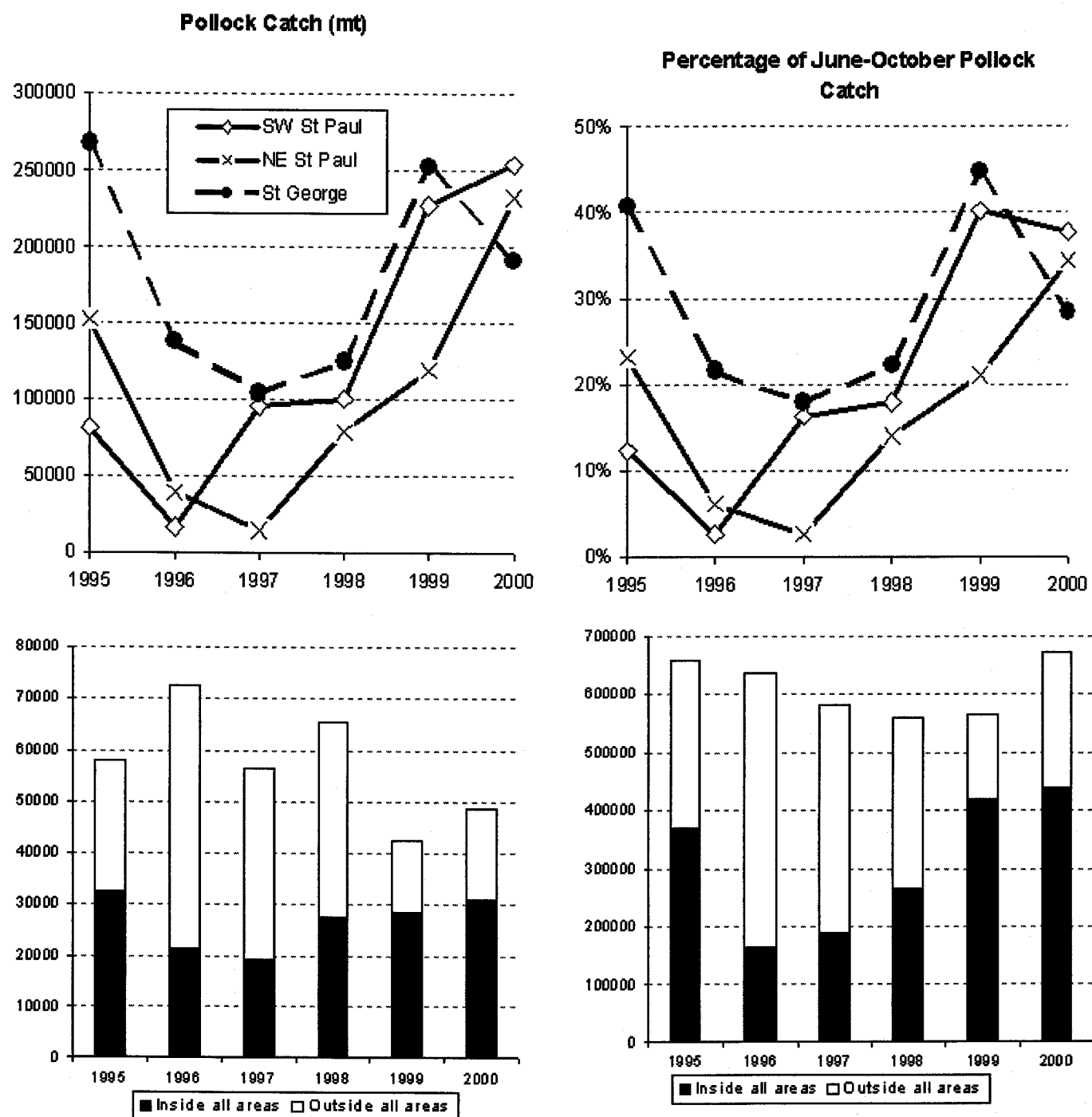
Table 4.1-11 Summary of effects of Alternatives 1 through 5 on northern fur seals.

Northern Fur Seals	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS-	CS-	CS-	CS-
Disturbance	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

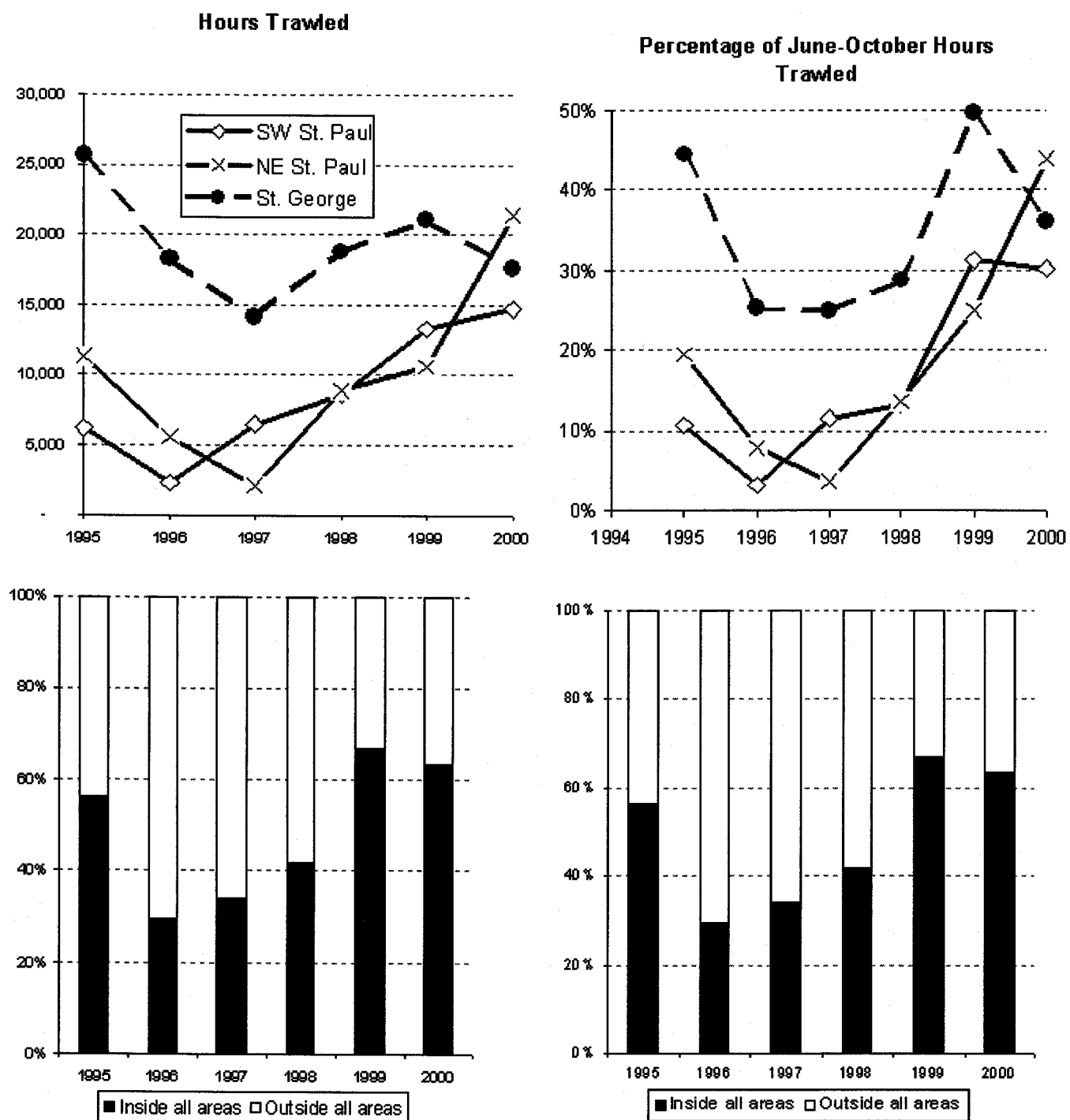
Under Alternatives 1-5, the effects of the groundfish fisheries on incidental take and harvest of prey species are expected to have insignificant population level effects on northern fur seals (Table 4.1-11), although the extent to which the FMP under any of the proposed Alternatives could change rates of fur seal entanglement in marine debris is unknown. Based on available information on northern fur seal foraging ecology during the breeding season, it is reasonable to conclude that the indirect effects of spatial and temporal fishery concentration under Alternatives 2-5 could plausibly have population level effects and are rated as conditionally significant negative under each alternative. The conclusion that the significance of these effects is conditionally negative for alternatives that open the fishery during June through August as well as September and October and close Steller sea lion foraging areas to fishing assumes that the displacement of the eastern Bering Sea pollock fishery northward into summer and fall foraging habitat of northern fur seals is likely to result in a competitive overlap with the fishery for fur seal prey, and spatial and temporal overlap with the fishery. Although increased vessel traffic could lead to a greater disturbance to fur seals and their prey the effects under each alternative are unknown.

Figure 4.1-1 Total catch of pollock during the summer and fall fishery in the eastern Bering Sea



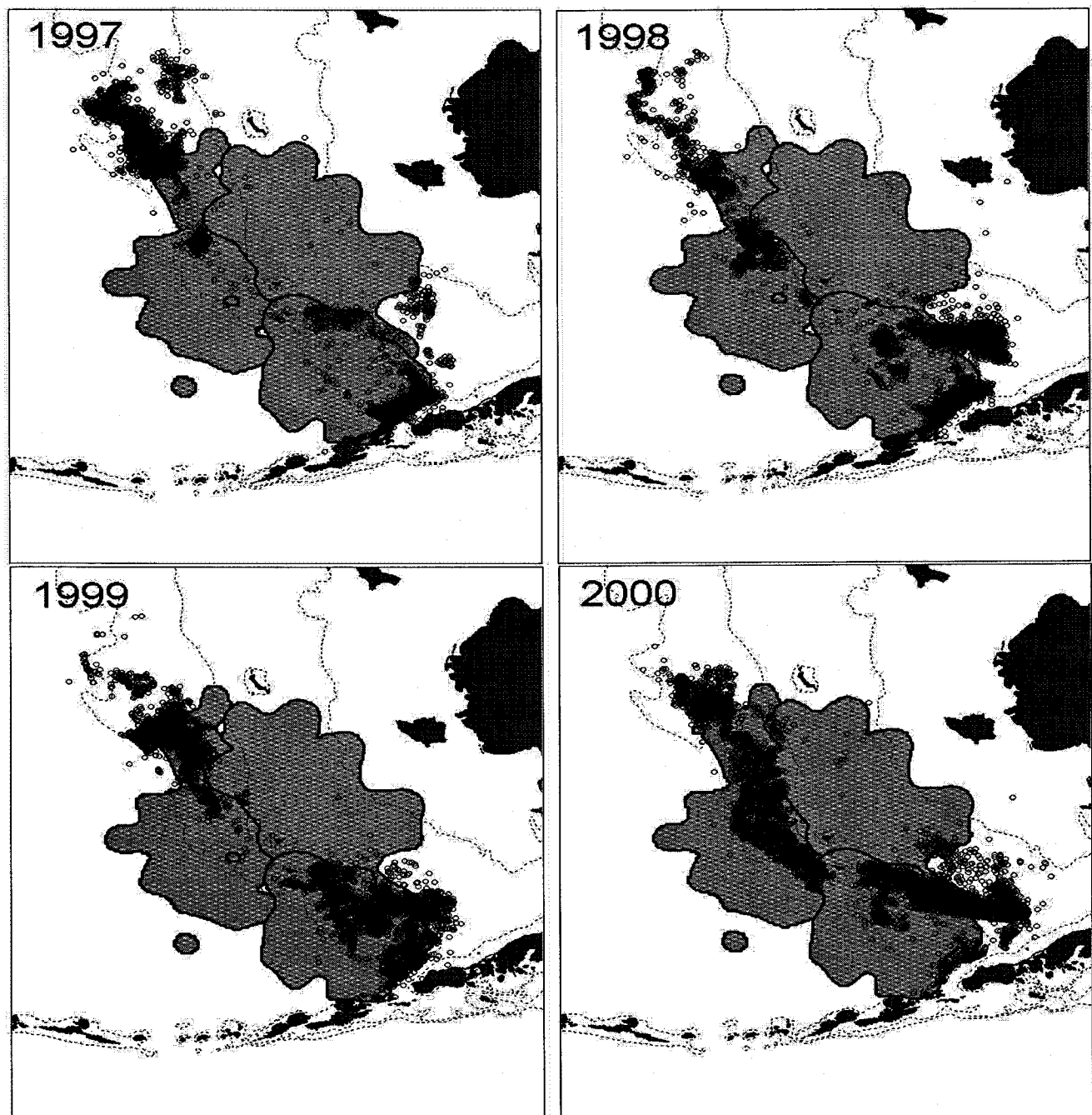
Note: Upper panels show the total catch and percentage of catch for meta-home range area from southwest St. Paul Island, northeast St. Paul Island, and St. George Island. Lower panels show the total catch inside and outside all areas combined.

Figure 4.1-2 Hours trawled during the summer and fall Pollock fishery in the eastern Bering Sea



Note: Upper panels show the hours trawled and percentage of hours trawled for meta-home range areas from southwest St. Paul Island, northeast St. Paul Island, and St. George Island. Lower panels show the total catch inside and outside all areas combined.

Figure 4.1-3 Location of trawls (circles) during the summer-fall eastern Bering Sea pollock Fishery in 1997-2000.



Source: The grey shaded areas show the meta-home range areas (see Figure 3.1.4-1) for lactating northern fur seals from St. Paul and St. George islands based on satellite telemetry data from 1995 and 1996 (Robson 2001)

4.1.5 Effects on Harbor Seals

Incidental takes of harbor seals by the groundfish fisheries operating the GOA and BSAI are uncommon. Harbor seal population estimates and trends are discussed in Section 3.1.5. Several harbor seal study sites have experienced dramatic population declines from the mid 1970s to the 1990s, however more recent population trends have shown a modest increase in numbers (Section 3.1.5). Direct and indirect interactions between harbor seals and groundfish fisheries occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important harbor seal prey, and due to temporal and spatial overlap in harbor seal foraging and commercial fishing activities. Of the groundfish species targeted for harvest Atka mackerel, pollock, and flatfish in the BSAI and pollock and Pacific cod in the GOA are important prey species for harbor seals (Section 3.1.5). Harbor seals exhibit a preference for nearshore habitat. These animals do not range far and feed at shallow depths on a variety of prey, including pollock, Pacific cod and Atka mackerel. The foraging habits of harbor seals are discussed in Section 3.1.5.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on harbor seals is outlined in Table 4.1-1.

4.1.5.1 Effects on Alternative 1 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

In both the GOA and BSAI, groundfish fisheries takes of harbor seals are at levels approaching zero and are insignificant factors in population trends. Reported cases of harbor seal entanglement in marine debris are less prevalent than for northern fur seals or Steller sea lions (Laist, 1987, 1997). Given their inshore distribution and the high frequency with which they are observed, the low incidence of entanglement is unlikely to be a result of few opportunities to document such events. Thus, the effect of direct take and entanglement in marine debris under Alternative 1 on harbor seal populations is rated as insignificant (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Pollock, Pacific cod and Atka mackerel are consumed by harbor seals in the GOA and BSAI area. The potential for competitive interaction from fisheries exists; however, competition would be largely dependent on the amount of fish removed and the temporal and spatial distribution of fishing effort. Daily removal rates as discussed in 4.1.1 and elsewhere are unlikely to effect near-shore feeding harbor seals and TAC levels are unchanged under Alternative 1. Thus, using the criteria for determining significance of effects on harbor seal populations in Table 4.1-1, Alternative 1 is given an insignificant ranking (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Harbor seals exhibit a preference for nearshore habitat. These animals do not range far and feed at shallow depths on a variety of prey, including pollock, Pacific cod and Atka mackerel. Harbor seals would receive some protection from competitive interaction for prey resources under Alternative 1 to the extent that no transit/no trawl fishing areas exist within 3-20 nm of shore in areas of Steller sea lion haulout sites and rookeries that overlap with harbor seal locations. This is particularly so in the Aleutian Islands area where many of the no transit and trawl exclusion zones exist. A lesser degree of protection would be afforded in the Gulf of Alaska where fewer restricted areas are described in areas that overlap with nearshore harbor seal distribution. Few spatial restrictions exist around the Kodiak Archipelago, an area of significant harbor seal

decline. A similar situation exists for Prince William Sound; however, the extent of federal groundfish fisheries in PWS is not great. Spatial and temporal concentration of the fisheries are unchanged under Alternative 1. Using the criteria for determining significance in Table 4.1-1, Alternative 1 is rated as conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Effects from disturbance are difficult to identify. Effects could result from acoustic impact in the environment, both above and in the water; direct displacement of animals from a feeding area; or displacement of prey, reducing the foraging efficiency of the harbor seals. Some local individual impact could occur for any one of the described effects. However, population level impacts are largely unknown for this type of effect. To the extent that fishing occurs in nearshore habitat and overlaps with harbor seal foraging areas, some unquantifiable amount of disturbance could occur. The effect would likely be negligible unless vessels were highly concentrated for a long period of time in a given area. Under Alternative 1 the level of disturbance is unchanged and is considered insignificant.

4.1.5.2 Effects of Alternative 2 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Historical data indicate that the rate of incidental take of harbor seals in the Gulf of Alaska and Bering Sea is very low and does not pose a population level problem to these animals (i.e. less than 1 percent of the PBR in the BSAI and less than 0.2% in the GOA). Low TAC amounts under Alternative 2 (compared to TAC levels under Alternative 1) would most likely reduce the number of harbor seals taken by these fisheries. This effect is considered insignificant because the level of take is already at a level that does not pose a biological threat to harbor seal populations. The effect on harbor seal populations under Alternative 2 is considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

For Alternative 2, the deviation difference (described in section 4.1.1.1 and elsewhere) for pollock in the Bering Sea resulted in a +198 value (CS-), partly because this Alternative alone proposes seasonal fishing from November to December. Negative values (I to CS+) were calculated in the Aleutian Islands and Gulf of Alaska for pollock and cod. Atka mackerel removals were positive for the EBS/AI and western Aleutian Island (CS-) and insignificant for the central Aleutian. Overall, Alternative 2 had a +38 value (Table 4.1-3), suggesting more fish removed compared to the mean daily removal rate of all Alternatives. The deviation difference for all fisheries and all areas was insignificant with a value of +38, suggesting that the combined removals of walleye pollock, Pacific cod, and Atka mackerel on a daily basis were similar to all Alternatives.

Alternative 2 greatly reduces the TAC in the GOA and BSAI, which would result in a reduced competitive interaction occurring with harbor seals. In addition to the TAC reductions maximum daily catch limits are also imposed under Alternative 2 and are likely to provide beneficial effects to foraging harbor seals.

Thus, Alternative 2 provides greater protection from effects of harvesting harbor seal prey species than Alternative 1. Further, the reductions in TACs are substantial enough (i.e., more than 20%, for two key species) to rank them as conditionally significant positive according to the significance criteria established in Table 4.1-1. The combination of a positive average daily removal rate (deviation difference) resulting in an insignificant rating, and the TAC ranking of CS+, results in an overall ranking of Insignificant for this Alternative under question 2.

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Temporal distribution also acts to increase the availability of prey. Four seasons would be established for pollock, Atka mackerel, and Pacific cod with 25% allocation by season. No rollover of TAC into the next season would be allowed. The temporal distribution at this level significantly redistributes the harvest over the whole year, preventing a greater amount of fish from being taken very early on in the year. For example, under Alternative 2, 25% of the TAC amount would be available between January 20 and March 15 compared to 50 % of a greater TAC being available over virtually the same time period (Jan. 20 to April 15). This measure should make more prey available in the winter months. Daily catch limits are also established under Alternative 2.

No fishing zones are established within 3 nm of all major haulout sites; no transit zones within 3 nm of 37 rookeries and no trawling for any groundfish species within SSL critical habitat. These restrictions result in fairly extensive protection areas throughout the GOA and BSAI range of harbor seals, including areas of special concern around significantly depressed populations (i.e. Kodiak). These protection areas also exist in nearshore habitat, important to harbor seal activity. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 2 is conditionally significant positive.

Indirect Effects – Disturbance Effects (Question 4)

Effects from disturbance are considered to be minimal under Alternative 2 because most of the nearshore habitat in which harbor seals undertake most of their activities has some degree of protection from fishing activity. Disturbance to harbor seals from fishing activities is generally considered to be minimal with no evidence to gauge population level effects. The disturbance effect on harbor seal populations under Alternative 2 is considered insignificant.

4.1.5.3 Effects of Alternative 3 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The TAC levels under Alternative 3 will be somewhat reduced from Alternative 1 but higher than in Alternative 2. GOA pollock would have lower TACs than in Alternative 1. Given that the incidental take of harbor seals in these fisheries is already at a negligible level, further reductions in TAC would reduce the incidental bycatch. The effect of this reduction, however, would not represent a significant positive impact to harbor seal populations. The effects on harbor seal populations under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels for the prey species pollock, Pacific cod, and Atka mackerel (with the exception of pollock in the GOA) are unchanged under Alternative 3. Lower harvests of pollock in the GOA could be marginally better for harbor seals provided that the effort in areas significant to harbor seals also decreases. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 3 is rated insignificant (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Similarly to Alternative 1 and 2, Alternative 3 creates no transit zones within 3 nm of 37 rookeries and no fishing zones within 3 nm of haulout sites. Some of the closure areas overlap with areas of harbor seal

haulout sites. As a result, harbor seals would also benefit from these closures. Alternative 3 also establishes substantial seasonal reductions in the amount of pollock and Pacific cod which may be harvested within Steller sea lion critical habitat. Alternative 3 establishes large open and closed areas from Prince William Sound to the end of the Aleutian chain. Increased protection for harbor seals would occur in the central and western Aleutian Islands areas. An open area in the eastern Aleutian Islands; however, would not be beneficial to harbor seals except in select nearshore sites where no fishing closures are in effect around rookeries that overlap with harbor seal distribution.

Additional open areas of concern for harbor seals are around the southern part of Kodiak Island (area 3 under this Alternative), area 5, and area 7. Numerous harbor seal haulout sites occur in these areas. The Kodiak area has experienced a significant decline in harbor seal populations over the last 20 years (~80%). While some increase in population has occurred in recent years, the population remains significantly depressed from historical levels. To the extent that fishing effort might be concentrated in this area, that effort could put additional pressure on foraging harbor seals. Similar concerns exist for the other open areas; although population trends are less well understood for these additional areas.

Temporal closures in critical habitat during the winter would mitigate some of this impact; however, to the extent that fishing effort occurs in relatively defined open areas in the summer when harbor seals are pupping and nursing their young, the animals' ability to find adequate forage could be reduced. Temporal distribution of fishing effort both inside and outside critical habitat could provide some degree of mitigation to the above-described effects.

Fishing under federal groundfish TACs in Prince William Sound are probably not extensive; however this is an open area for fishing that is of concern relative to harbor seals. The population trend for this area is declining and fishing pressure in this area could place an additional burden on these animals.

Catch limits inside critical habitat are likely to be beneficial to harbor seals by leaving more prey available for forage. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 3 is conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Disturbance effects would be minimized by the implementation of closure areas. To the degree that fishing becomes more concentrated in open areas, harbor seals in those areas could experience an increased disturbance effect. Disturbance to harbor seals by fishing effort, is, however, generally considered to be minimal with no evidence to gauge population level effects. The disturbance effects on harbor seal populations under Alternative 3 are considered insignificant.

4.1.5.4 Effects of Alternative 4 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The TAC under Alternative 4 is virtually unchanged from the TAC level under Alternative 1 or 3; therefore this harvest removal level is, overall, not expected to change the incidental take amount of harbor seals or entanglements from marine debris. The existing incidental take is at a negligible level that is predicted not to affect the population(s) of harbor seals in the Bering Sea or Gulf of Alaska. The effects on harbor seal populations under Alternative 4 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels for pollock, Pacific cod, and Atka mackerel would not change under Alternative 4. Some degree of competitive interaction by the pollock, Atka mackerel and Pacific cod fisheries would occur with harbor seals. Based solely on the amount of prey removed, the intensity interaction would be similar to that occurring under Alternative 1 and lesser than under Alternative 2. Daily removal rates as discussed in 4.1.1 and elsewhere are unlikely to effect near-shore feeding harbor seals and TAC levels are unchanged under Alternative 1. Thus, using the criteria for determining significance of effects on harbor seal populations in Table 4.1-1, Alternative 4 is given an insignificant ranking (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

This alternative provides minimal global protections in nearshore habitat. No transit zones and no fishing zones occur within 3 nm of 37 rookeries and no fishing occurs within 0 - 20 nm of only 5 northern haulout sites. In this regard, the nearshore protection is more selective and less consistent than in the other alternatives.

To the extent that closed areas exist in nearshore areas that overlap with harbor seal haulout sites this alternative will afford some protection to harbor seals. For example, closures to Atka mackerel fishing in the Aleutian Islands and fishing to pollock fishing in the central and western Aleutian Islands exist in critical habitat area that overlaps, for the most part, with the distribution of harbor seals in this portion of their range. Fishing closures for Pacific cod in the BSAI in nearshore habitat would also provide some protection from competitive interaction as would the closures nearshore in the Gulf of Alaska. However, this alternative leaves open a large extent of the eastern and southern areas of Kodiak island to pollock and some Pacific cod fishing.

To the extent that the east and south sides of Kodiak Island remain open to fishing, some increased pressure could be present for harbor seals in these nearshore areas. As discussed above, the harbor seal population in the Kodiak Archipelago has suffered a significant decline in the last 20 years and has not recovered to historical levels.

Alternative 4 creates the option for some fixed gear, small vessel, nearshore fishing. Some of the nearshore waters in the Chignik area contain haulout sites of harbor seals that could be affected by the nearshore harvest of Pacific cod. Exemption areas around Dutch Harbor also contain numerous harbor seal haulout sites that could be affected negatively by fishing pressure on Pacific cod in the nearshore environment. Graduated zones of forage areas in the GOA for Pacific cod could provide some reduction in competitive interaction by minimizing the removal in nearshore areas.

The temporal dispersion of TAC harvest throughout the year so as to minimize large scale removals in any one area could provide some benefit to harbor seals. However, depending on the nature of the temporal dispersion as well as the nature of the fishing effort within the season the pressure may effectively not be reduced. For some fisheries, temporal dispersion occurs but a significant proportion of the TAC may be taken in a given season. For example, the Aleutian Island pollock TAC is fished in one season beginning January 20; the BS and AI cod trawl fisheries have 80% of the TAC apportioned from January 20 to June 10. In those instances when the TAC is heavily weighted to one season the true positive effect of temporal dispersion is not gained.

This is also true for the allocation of TAC by areas. For example, TAC in the AI Atka mackerel fishery is apportioned inside and outside critical habitat. The apportionment (70%/30%, respectively), however, allows more fishing to occur in nearshore habitat. While this represents some improvement over all of the TAC

being harvested from within critical habitat, the removals are heavily weighted to areas inside critical habitat. This is the area in which harbor seals are more vulnerable to competitive pressure. Harbor seals would be particularly vulnerable at times when prey biomass is generally low and these times overlap with periods of high energetic demand, such as pupping and weaning, or during winter months. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 4 is conditionally significant negative (Table 4.1-10).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 4 is not expected to cause disturbance effects any different from those already discussed under other alternatives. These effects are considered to be minimal. The disturbance effects on harbor seal populations under Alternative 4 are considered insignificant.

4.1.5.5 Effects of Alternative 5 on Harbor Seals

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

As previously discussed, the incidental take of harbor seals in the BSAI and GOA fisheries is minimal and not considered to be problematic for harbor seal populations. That take level is not expected to change under Alternative 5. The effects on harbor seal populations under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-12).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

TAC levels under Alternative 5 are comparable to Alternatives 1, 3, and 4; although AI pollock TAC is significantly lower and more comparable to Alternative 2. As discussed above, some degree of competitive interaction is expected to occur; although the degree is unknown. Using the criteria for determining significance in Table 4.1-1 the effect on harbor seal populations under Alternative 5 is rated insignificant (Table 4.1-12).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

Rookery closures exist under Alternative 5; however, more global nearshore closures are absent from this alternative. Closures within 10 and 20 nm of 37 rookeries are considered to be beneficial to harbor seals where harbor seals haulout sites are found within the described areas. The area of greatest overlap in closure areas occurs in the Aleutian Islands. Harbor seals are much more widely dispersed in the GOA than the rookery closure areas. No pollock fishing zones are established within 10 or 20 nm of 75 haulout sites seasonally (January to June) or when Steller sea lions are present. The seasonal nature of the closures, however, is less protective than were they to remain in place year round. Spatial closures are minimal for the various fisheries under Alternative 5. To the extent that areas are left open for nearshore fishing for Pacific cod in the GOA, and seasonally for pollock, harbor seals are afforded less protection. Generally some large open areas exist, particularly in the Kodiak region, where fishing pressure concentrated in these areas could be problematic for the depressed harbor seal population.

Harvest limits (i.e. inside v. outside critical habitat) and seasonal allocations of pollock, cod and Atka mackerel would improve the availability of forage for harbor seals. The temporal distribution of TAC appears to be more evenly distributed than for some of the other alternatives. To the extent that large amounts of the TAC are not removed at a specific time of the year (and in particular during the early summer months when animals are pupping and weaning their young, as well as potentially in the winter) this provides greater opportunity for prey to be available to harbor seals. Using the criteria for determining significance in Table

4.1-1 the effect on harbor seal populations under Alternative 5 is conditionally significant negative (Table 4.1-12).

Indirect Effects – Disturbance Effects (Question 4)

Alternative 5 is not expected to cause disturbance effects any different than those already discussed under Alternative 1. These effects are considered to be minimal. The disturbance effects on harbor seal populations under Alternative 5 are considered insignificant.

4.1.5.6 Summary of Effects on Harbor Seals

The criteria used to determine the significance of effects on harbor seals is outlined in Table 4.1-1. Table 4.1-12 summarizes the effects of the alternatives on harbor seal populations.

Table 4.1-12 Summary of effects of Alternatives 1 through 5 on harbor seals.

Harbor Seals	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	CS-	CS+	CS-	CS-	CS-
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Harbor seals would benefit most from management measures that displace pollock, cod and Atka mackerel fisheries farther offshore (i.e. greater than 20 nm) throughout much of the GOA and BSAI areas. Harbor seals are distributed almost continuously from Cape Suckling to the end of the Aleutian chain. The areas of greatest known concern for harbor seals are in Prince William Sound, the Kodiak area because populations in these areas have declined substantially in the last 20 years and remain depressed or continue to decline. Competitive interaction from fisheries that harvest pollock, cod and Atka mackerel in these areas could place significant additional burden on these populations.

Populations in the Bering Sea and the Aleutian Islands could be equally vulnerable to nearshore fishing pressure for these same fish species; however, the trend data is not available at this time to the same extent for the BSAI as for other areas of the harbor seal range in the GOA for similar areas of concern to be identified.

In addition to measures that move the fishing effort farther from shore, those measures that spread the effort out in time and space, as well as reduce the overall harvest amounts that can be removed are also likely to provide a greater benefit to harbor seal foraging success. The greatest degree of protection under the alternatives presented is likely to come from Alternative 2 which affords the greatest global protection by creating closure areas throughout the harbor seal range which moves the effort beyond 10 and 20 nm, as well as reducing TAC. This alternative also apportions the TAC relatively evenly throughout the year, without significantly weighting any given season.

While some of the other alternatives accomplish similar objectives they do so in part and in a more fractured manner. In addition, the complexity of some of the alternatives exceeds the state of knowledge of harbor seal dynamics. The result may be that greater protection is afforded in some cases, or, conversely that little or no additional protection is created by the additional management complexity. In some cases, however, we can infer that a greater impact to harbor seals is likely to occur from certain management measures (e.g., open fishing areas in the GOA around Kodiak island or harvest that is disproportionately weighted by season or area in times for which harbor seals may be more vulnerable i.e. winter months or pupping times).

4.1.6 Effects of the Alternatives on Other Pinnipeds

The "other pinnipeds" group includes the ice seals (spotted, bearded, ringed, and ribbon seals), Pacific walrus, and northern elephant seal. Ecological interactions between these species and commercial groundfish fisheries are limited by both spatial separation and differences between commercial harvest targets and the species food habits. The alternative management measures would be expected to have little or no effect on those species where contact with commercial fisheries remained limited.

In particular, the ice seal distributions tend toward seasonally or permanently ice-covered waters of the Beaufort, Chukchi, Bering, and Okhotsk Seas, which are generally north of most areas commercially fished for groundfish. The annual distribution of the seals depends on the extent of the sea ice, which can vary widely from year to year (Burns *et al.*, 1981a, b). The sea ice in the Bering Sea typically extends to the continental shelf break, but in heavy ice years, the ice edge can extend as far south as the eastern Aleutian Islands, while in light ice years, the ice edge can be as far north as St. Lawrence Island (Burns *et al.*, 1981b). Occasionally, individuals of each species can be found south of the ice edge in the Bering Sea, but infrequent contacts with fisheries would not precipitate population level effects.

Of the ice seals, the spotted seals occur closest to groundfish fishing areas, inhabiting the front zone of the pack ice (the transition zone between the southern fringe of ice and the heavier southward-drifting pack ice; Burns *et al.*, 1981a, Braham *et al.*, 1984) during the winter and spring. Spotted seals move to coastal waters of the Bering and Chukchi seas in summer and fall (Braham *et al.*, 1984; Lowry *et al.*, 1998; 2000), where their nearshore distribution would limit their contact with groundfish fisheries in much the same way it would for harbor seals. Spotted seals are less dependent than harbor seals on commercially targeted fish, as the pollock eaten by spotted seals in the Bering Sea are of smaller size than commercially targeted pollock (Frost and Lowry, 1986). Ribbon seals also inhabit the front zone of the pack ice (Burns, 1970; Braham *et al.*, 1984). Ribbon seals feed on pollock, but the size classes targeted are smaller than commercially targeted pollock (Frost and Lowry, 1980; Frost and Lowry, 1986). Little is known of the distribution and food habits of ribbon seals during the open water season (July-November).

Bearded seals, ringed seals and walrus are found in pack ice in the winter and spring, north of the ice front (Braham *et al.*, 1984). Bearded seals are found throughout the pack ice; they are benthic feeders, and although they have been known to eat pollock, it does not make up a large part of their diet (Lowry *et al.*, 1996), and thus there is little overlap with commercially targeted prey. Ringed seals are distributed in heavy pack ice (Braham *et al.*, 1984) or shorefast ice (McLaren 1958; Burns, 1970; Smith and Stirling, 1975; Smith, 1987), and thus would have no interaction with fisheries. In summer and fall, most bearded and ringed seals move north with the receding ice, away from Bering Sea commercial fishing grounds.

Effects on Pacific walrus would be small because of differences in their distribution (especially concerning areas used by large aggregations) and commercial fishing grounds. During the winter, walrus aggregate in heavy pack ice (Braham *et al.*, 1984), where fishing vessels would not be present. Although Pacific walrus occur in the shelf waters of the Bering Sea in the summer, most of the population congregates at the southern edge of the Chukchi Sea pack ice during this time (Allen 1880; Smirnov, 1929; Fay *et al.*, 1984). With the

exception of adult males which remain in the Bering Sea during the summer, most habitat utilized by the population is associated with the availability of haulout sites on ice (Brooks, 1954; Burns, 1965; Fay, 1955; 1982; Fay *et al.*, 1984). Walrus remaining in the Bering Sea many use haulouts on Round Island, which is a State of Alaska preserve with a 12 nmi (22.2 km) no fishing zone established around it. Others may remain near haulouts on islands in the Bering Strait, the Punuk Islands, or the beaches at Cape Seniavin, all of which are adjacent to shallow waters not used by federally-managed groundfish fisheries.

Northern elephant seals occur in the GOA and Aleutian Islands during the spring and fall (Stewart and DeLong, 1994; LeBoeuf *et al.*, 2000). Males migrate to foraging areas near the continental shelf break, where they spend 26-89 days feeding (LeBoeuf *et al.*, 2000; Stewart and DeLong, 1994); during this time they dive to a mean depth of 1024 ft (312 m). Seldom seen, they appear to have little or no contact with commercial fisheries. Based on their more southerly distribution and the positive trend in their population status, we assume that the effects of Alternative 1 or any of the other alternatives on them would be insignificant.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on other pinnipeds is outlined in Table 4.1-1.

4.1.6.1 Effects of Alternative 1 on Other Pinnipeds

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take rates in commercial fisheries for ice seals, walrus and northern elephant seals are very low. NMFS observers on board BSAI groundfish trawl, longline, and pot fishing vessels from 1990 to 1999 and logbook data from Bristol Bay salmon drift gillnet fishery from 1990 to 1993 reported nine spotted seals, ten bearded seals, two ringed seals, and three ribbon seals taken, resulting in estimated takes of 2.5, 0.6, 0 and 0.2 seals per year, respectively (Angliss *et al.*, 2001). These rates constitute levels approaching zero according to NMFS standards (Angliss *et al.*, 2001). Of the approximately 17 Pacific walrus that were caught each year in groundfish trawl fisheries in the eastern Bering Sea between 1990 and 1997, over 80% were already decomposed and not likely to have actually been killed as a result of fisheries interactions (Gorbics *et al.*, 1998). At a rate of 17 walrus per year, the take rate qualifies as an insignificant level, approaching zero by NMFS standards. NMFS observers on board BSAI and GOA groundfish trawl, longline, and pot fishing vessels from 1990 to 1999 reported six northern elephant seals were incidentally taken in the trawl and longline fishery. This take rate constitutes a level approaching zero by NMFS standards (Forney *et al.*, 2000). Entanglement in marine debris is likewise rare for these species and is considered to have insignificant effects.

Of the federally-managed fisheries in Alaska, only the eastern Bering Sea and Aleutian Islands pollock fishery would be likely to have an impact on ice seals and walrus, because of their northern distribution in the Bering Sea. Calculated estimates of incidental takes for all marine mammals (Table 4.1-2) indicate that in the eastern Bering Sea and Aleutian Islands pollock trawl fishery, 13 marine mammals other than Steller sea lions would be taken under Alternative 1. Given that only a few of these 13, if any, would be ice seals or walrus, this rate of incidental take constitutes a level approaching zero. Because of their distribution in Alaska in the Gulf of Alaska and south of the Aleutian Islands (Stewart and DeLong, 1994; LeBoeuf *et al.*, 2000), northern elephant seals would be likely to be affected only by the Gulf of Alaska and Aleutian Islands pollock and cod fisheries. Calculated estimates of incidental takes for all marine mammals (Table 4.1-2) indicate that in the Gulf of Alaska and Aleutian Islands fisheries, four marine mammals other than Steller sea lions would be taken under Alternative 1. This incidental take rate constitutes a level approaching zero for northern elephant seals.

Overall, direct effects on the other pinnipeds stemming from incidental take or entanglement in marine debris are considered insignificant. The effects on other pinniped populations under Alternative 1 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

With the exception of spotted seals and ribbon seals, the food habits of the ice seals do not overlap with commercial fisheries targets. Bearded seals consume primarily benthic prey including crabs and clams as well as shrimps and Arctic cod (Kosygin, 1966; 1971; Lowry *et al.*, 1980a; 1981a; 1981b). Ringed seals eat Arctic cod, saffron cod, smelt, herring, shrimps, amphipods and euphausiids (McLaren, 1958; Fedoseev, 1965; Johnson *et al.*, 1966; Lowry *et al.*, 1980b). Ribbon seals eat crustaceans, cephalopods, and fish, including pollock, Arctic cod, saffron cod, capelin, eelpout, sculpins, and flatfish (Arsen'ev, 1941; Shustov, 1965b; Frost and Lowry, 1980; Burns, 1981b; Lowry *et al.*, 1996). Spotted seals include pollock in their diet when feeding in the central and southeast Bering Sea (Bukhtiyarov *et al.*, 1984; Sobolevskii, 1996). Spotted seal diet is not very dependent on commercially harvested fish species, as the pollock they target are smaller (mean length 4.2 in [10.9 cm] in the Bering Sea and 6.2 in [15.9 cm] in the Okhotsk Sea; Frost and Lowry, 1986; Lowry *et al.*, 1996) than commercially targeted pollock (greater than 11.7 in [30 cm] in length; Wespestad and Dawson, 1992). Likewise, ribbon seals target smaller fish (1-year-old fish, mean length 4.4 in [11.2 cm]) than commercially targeted pollock (Frost and Lowry, 1980; Frost and Lowry, 1986). Thus, the effects on ice seals are insignificant under Alternative 1.

The diet of Pacific walrus is composed almost exclusively of benthic invertebrates (97%), particularly bivalve molluscs. Fish ingestion has been considered incidental to their normal feeding behavior (Fay and Stoker, 1982b). Groundfish removals would not have a meaningful effect on walrus populations. The diet of northern elephant seals in the GOA is unknown; however, the species is known to be a deep diver in Alaskan waters (Stewart and DeLong, 1994; LeBoeuf *et al.*, 2000). This behavior suggests that their foraging may be partitioned by depth from most groundfish fishing activities. The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 1, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walrus with groundfish fisheries. The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 1, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small under all of the alternatives. Individual animals in the pinniped group venturing into fishing areas could temporarily modify their behavior; however, those cases would not constitute population level effects. Alternative 1 would not cause disturbance effects that would affect ice seals, walruses or northern elephant seals at a population level. The disturbance effects on other pinniped populations would be similar under Alternative 1 and are considered insignificant.

4.1.6.2 Effects of Alternative 2 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 2 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 2; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, one marine mammal other than Steller sea lions would be taken under Alternative 2 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

The closure of the Steller sea lion Conservation Area in the Bering Sea to fishing vessels may result in a shift of fishing vessels northwards toward the Pribilof Islands and along the continental shelf break in the Bering Sea, as described in the Effects on Northern Fur Seals (Section 4.1.4). This northward redistribution of fishing vessels may result in closer proximity of fishing vessels to the ice edge during January-April, which may increase direct interaction with spotted and ribbon seals. The extent of such interaction is difficult to quantify, as it depends on the location of the ice edge as well as fishing locations: if the ice edge is farther north than usual, then the probability of increased direct interaction is small, but if the ice edge is at the continental shelf or farther south, then direct interaction may increase. However, because the extent of such interaction cannot be assessed, and is not likely to have population effects on ice seals. The effects on other pinniped populations under Alternative 2 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging habitat, and thus reduces the total amount of target and bycatch species from the amount caught in Alternative 1. Given that the TACs of several prey species are reduced by 5% to 20% in the BSAI and the lack of overlap between fisheries and the foraging behavior of ice seals, northern elephant seals and walrus the effects on other pinniped populations under Alternative 2 are considered insignificant.

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walruses with groundfish fisheries. The criteria used for determining the significance of an alternative's effect on pinniped populations requires much less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of conditionally significant positive (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. Although this criteria is met under Alternative 2 given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects under Alternative 2 and so is rated insignificant.

Indirect Effects – Disturbance Effects (Question 4)

In general, there is little spatial or temporal overlap of ice seals, northern elephant seals, and walrus with groundfish fisheries; the only spatial and temporal overlap would depend on the extent of sea ice during the January-May time period, as described in Section 4.1.6.2. Because spotted seals and ribbon seals are distributed along the front zone of pack ice during January-April (Burns, 1970; 1981b; Lowry *et al.*, 2000), seals may be disturbed by fishing vessels that venture close to the leading edge of the ice. Spotted seals are more likely to be disturbed than ribbon seals, as they are distributed in the southern part of the ice front (i.e., closer to the ice edge; Burns *et al.*, 1981b; Braham *et al.*, 1984) and they are easily disturbed into the water when they are hauled out on ice (Braham *et al.*, 1984; Lowry, 1984). The effect of this disturbance would be greatest during March-May, when spotted seals have pups on the ice (Burns *et al.*, 1981b; Braham *et al.*, 1984; Lowry, 1984), and during the molting season from May-June, when larger groups (concentrations of tens to hundreds) of spotted seals are hauled out on ice remnants (Lowry, 1984). One concern during the pupping season is that disturbance of nursing mothers, if repetitive, could result in abandonment of pups or hauling areas (Lowry, 1984). As noted in Section 4.1.6.2, if the closure of Steller sea lion Conservation Area results in a northern shift of fishing activity closer to the ice edge, there may be an increase in disturbance effects for spotted seals; however, this is difficult to quantify and may not result in a substantial change in disturbance effects.

Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small under Alternative 2. Individual animals in the pinniped group venturing into fishing areas could temporarily modify their behavior; however, those cases would not constitute population level effects. Alternative 2 would not cause disturbance effects that would affect ice seals, walrus or northern elephant seals at a population level. The disturbance effects on other pinniped populations under Alternative 2 are considered insignificant.

4.1.6.3 Effects of Alternative 3 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 3 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 3; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, three marine mammals other than Steller sea lions would be taken under Alternative 3 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase direct interaction with spotted and ribbon seals. However, because the extent of such interaction cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. The effects on other pinniped populations under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further

discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 3, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

In general, there is little spatial, temporal, or dietary overlap of ice seals, northern elephant seals, and walrus with groundfish fisheries. Based on the reduction of the temporal and spatial concentration of the fisheries under Alternative 3 and given the lack of overlap with regard to species consumed versus fishery targets, the effects on other pinniped populations are considered insignificant under Alternative 3, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

As with Alternative 2, closure of RPA Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase disturbance effects on spotted seals (Section 4.1.6.2). However, the extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walrus, or northern elephant seals under Alternative 3. The disturbance effects on other pinniped populations would be similar under Alternative 3 and are considered insignificant.

4.1.6.4 Effects of Alternative 4 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 4 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 4; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, four marine mammals other than Steller sea lions would be taken under Alternative 4 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

Under Alternative 4, only the Steller sea lion Conservation Area will be closed to trawling for pollock, and catcher-processors will be excluded from the CVOA from June 10-December 31. Because the winter season is not affected by the exclusion of catcher-processors from the CVOA, the northward shift of fishing vessels (Section 4.1.6.2) may not be as marked as in Alternative 2 or 3, and potential for interaction with ice seals may not increase. However, because the extent of such interactions cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals, the effects on other pinniped populations under Alternative 4 is considered insignificant, with respect to incidental take and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further

discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 4, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 4, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Under Alternative 4, only the Steller sea lion Conservation Area will be closed to trawling for pollock, and catcher-processors will be excluded from the CVOA from June 10-December 31. Because the winter season is not affected by the exclusion of catcher-processors from the CVOA, the northward shift of fishing vessels (Section 4.1.6.2) may not be as marked as in Alternative 2 or 3, and potential for increased disturbance of seals may not increase. The extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walruses, or northern elephant seals under Alternative 4. The disturbance effects on other pinniped populations would be similar under Alternative 4 and are considered insignificant.

4.1.6.5 Effects of Alternative 5 on Other Pinnipeds

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

The incidental take of other pinnipeds in the groundfish fisheries under Alternative 5 is expected to mirror rates under Alternative 1. In the Eastern Bering Sea and Aleutian Islands pollock trawl fishery, only 13 marine mammals other than Steller sea lions would be taken under Alternative 5; this is considered a level approaching zero for ice seals and walrus. For northern elephant seals, four marine mammals other than Steller sea lions would be taken under Alternative 5 in the Gulf of Alaska and Aleutian Islands pollock and cod fisheries; this is considered a level approaching zero.

Alternative 5 is derived from the suite of RPA measures that were in place for the 2000 pollock and Atka mackerel fisheries. Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands, due to the closure of the Steller sea lion Conservation Area. As such, fishing vessels may be operating closer to the ice edge during January-April, which may in turn increase direct interaction with spotted and ribbon seals. However, because the extent of such interaction cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Overall, direct effects on the other pinnipeds stemming from incidental take or entanglement in marine debris are considered insignificant. The effects on other pinniped populations under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-13).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The criteria used for determining the significance of an alternative's effect on pinniped populations set TAC removals for one or more key prey species at a level 5% to 20 % lower as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for lowered TACs has not been met, based on the lack of overlap between fisheries and the foraging behavior of ice seals, walrus and northern elephant seals (Section 4.1.6.1), the effects are considered insignificant under Alternative 5, with respect to the harvest of prey species (Table 4.1-13).

Indirect Effects – Spatial and Temporal Concentration of Fishery (Question 3)

The criteria used for determining the significance of an alternative's effect on pinniped populations requires marginally less temporal and spatial concentration of the fisheries as a benchmark for reaching a conclusion of insignificance (Table 4.1-1). These benchmarks are intended to serve as basis for further discussion with respect to the intensity of impacts on pinniped populations. While this criteria for reduced temporal and spatial concentration of the fisheries has not been met, given the lack of overlap with regard to species consumed versus fishery targets, there would be no spatial or temporal effects. The effects on other pinniped populations are considered insignificant under Alternative 5, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

As with Alternative 2, closure of the Steller sea lion Conservation Area under Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands and continental shelf, and may result in closer proximity of fishing vessels to the ice edge during January-April, which may in turn increase disturbance effects on spotted seals (Section 4.1.6.2). However, the extent of such disturbance cannot be assessed because of variability in the extent of the sea ice edge (Section 4.1.6.2), and is not likely to have population effects on ice seals. Given the general lack of spatial, temporal, or dietary overlap with groundfish fisheries, disturbance effects caused by vessel traffic, noise, or fishing gear are likely to be small for ice seals, walruses, or northern elephant seals under Alternative 5. The disturbance effects on other pinniped populations would be similar under Alternative 5 and are considered insignificant.

4.1.6.6 Summary of Effects on Other Pinnipeds

The criteria used to determine the significance of effects on other pinnipeds is outlined in Table 4.1-1. In cases where the criteria in Table 4.1-1 for a rating of conditionally significant positive or negative were met but not used for questions 2 and 3, these cases are discussed in the analyses of the individual alternatives above. Table 4.1-13 summarizes the effects of the alternatives on other pinniped populations. In all cases, the direct and indirect effects of all alternatives are expected to have insignificant effects on other pinnipeds (Table 4.1-1) because there is little spatial, temporal or dietary overlap of ice seals, northern elephant seals and walruses with groundfish fisheries.

Table 4.1-13 Summary of effects of Alternatives 1 through 5 on other pinnipeds.

Other Pinnipeds	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.1.7 Effects on Sea Otters

The USFWS estimates the total sea otter population size in Alaska at 70,500 (USFWS, unpublished)¹⁷. Currently, only the sea otter stock in California is listed as threatened under the ESA; the population in Alaska is neither listed as threatened or endangered under the ESA nor as depleted under the Marine Mammal Protection Agency. However, the Alaskan population has been experiencing severe declines in the central portion of its range in recent years (Estes *et al.*, 1998). As a result, the USFWS is conducting a formal review to determine whether or not the Alaskan population should be considered for listing pursuant to the ESA. Estes *et al.* (1998) suggested that increased predation by killer whales is the likely cause of these declines. Further, the authors speculate that the increased predation may have resulted from declines in the populations of other killer whale prey, namely Steller sea lions and harbor seals. If this hypothesis is correct, then any impact the groundfish fisheries may have on Steller sea lion recovery could also be considered a factor in the sea otter declines, in so far as they may have contributed to a shift in predator-prey relationships. Having said that, no data currently exist to test the validity of this hypothesis and for the purposes of this analysis, only the proximal effects of fisheries on sea otters can be evaluated.

The alternatives are discussed below in terms of four potential effects: 1) direct effects (incidental take or entanglement in marine debris), 2) fisheries harvest of prey species, 3) temporal and spatial concentration of the fishery, and 4) disturbance effects. The criteria used for determining the significance of effects on sea otters is outlined in Table 4.1-1.

4.1.7.1 Effects of Alternative 1 on Sea Otters

Direct Effects – Incidental Take/Entanglement in Marine Debris (Question 1)

Sea otter interactions with fishing gear, either passive or active are infrequent. Laist (1997) reported that sea otter entanglement in marine debris is rare. Likewise, incidental takes in fishing gear occur at a rate too low to cause population level effects. While the PBRs for the three sea otter stocks in Alaska were 871 (southeast), 2,095 (southcentral) and 5,699 (southwest), mortalities incidental to commercial fishing were 0, less than 1, and less than 2 per year, respectively.

A recent summary by population stock related to groundfish interactions was provided by the USFWS. For the southeast stock, no mortality was reported from 1990-1993. Self-reported fishers were incomplete for

¹⁷R. Meehan, "Personal Communication," 1011 E. Tudor Road, Anchorage, AK 99503.

1994 and not available for succeeding years. In south-central Alaska, Self-reported fishers show one kill and four injuries in 1990 due to gear interactions and three injuries due to deterrence in Prince William Sound, Copper River, and Bering River drift-gillnet fishery. No mortalities were reported from 1991 to 1993 and 1996. There are no current estimates for 1997 to the present. In southwest Alaska, the NOAA observer program reported eight kills in the Aleutian Islands black cod pot fishery in 1992. No other sea otter kills were reported by NOAA observers in the region from 1990 to 1996. One kill from gear interactions was self-reported in the Alaska-Kodiak salmon gillnet fishery in 1991. Otherwise, no kills were reported from 1990 to 1993 and 1996. In the 2000 "List of Fisheries" sea otters were added to the Bering Sea and Aleutian Islands groundfish trawl as a "species recorded as taken in this fishery." The USFWS is currently pursuing information regarding the extent of that possible interaction.

The total fishery mortality and serious injury for the Alaska sea otter is considered to be insignificant (i.e., less than 10% of the calculated PBR). The effects on sea otters under Alternative 1 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

The effects of the alternatives on sea otters are limited by differences between their prey and the fisheries harvest targets. Sea otters consume a wide variety of prey species, including annelid worms, crabs, shrimp, mollusks (e.g., chitons, limpets, snails, clams, mussels, and octopus), sea urchins, and tunicates. Occasionally, groundfish (e.g., sablefish, rock greenling, and Atka mackerel) may also be consumed but invertebrates are considered the predominant elements of their diet. Given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.1, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 1, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

There is little basis for suggesting competition for forage between sea otters and commercial fisheries occurs, despite the species broad geographical distribution in the Gulf of Alaska and the Aleutian Islands. Sea otters inhabit waters of the open coast, as well as bays and the inside passages of southeastern Alaska. Because their primary prey items are found on the bottom in the littoral zone, to depths of 164 feet (50 m), the majority of otters feed within 0.6 miles (1 km) of the shore (Kenyon 1981). In areas, where shallow waters extend far offshore (e.g., Unimak Island), sea otters have been reported as far as 10 miles (16 km) offshore. They are often seen resting and diving for food in and near kelp beds (Kenyon 1969). Because of this habitat preference for shallow areas, they do not overlap spatially with groundfish fisheries. For the reasons discussed in Section 4.1.6.1, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 1, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

There are several sources of potential Level B harassment of sea otters in the coastal waters of Alaska. These include: small boat traffic (boat strikes), float plane landings and take offs, and mariculture sites. Other potential sources of disturbance include changes in forage behavior to include feeding on fish offal and foraging in harbor areas which have heavy contamination. USFWS has no data at present to suggest that any one of these factors alone are impacting sea otters at the population level.

As noted for many of the other marine mammals, the effects of disturbance caused by vessel traffic, fishing operations, or sound production on sea otters in the GOA and BSAI are expected to be not significant. Sea otters exhibit considerable tolerance for vessel traffic and in some cases are attracted to small boats passing by (Richardson *et al.*, 1995). Sea otters may be more tolerant of underwater sound relative to other species, owing to the greater amount of time they spend at the surface. Overall, given these attributes, as well as the spatial partitioning of sea otters and groundfish fishing operations, disturbance effects are considered to be minimal under all of the alternatives. The disturbance effects on sea otters would be similar under Alternative 1 and are considered insignificant.

4.1.7.2 Effects of Alternative 2 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

With regard to incidental take, Alternative 2 is not likely to result in significant changes in the rate of direct mortality relevant at the population level. Under Alternative 2, TACs for pollock, Pacific cod, and Atka mackerel are reduced; thus, proportional reductions in incidental take could be expected. However, the apportionment of the TAC reductions did not result in the reduction of the expected incidental catch of Steller sea lions. With respect to entanglement in marine debris, Alternative 2 does not alter the effects described under Alternative 1. That is, the effect is insignificant. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 2 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 2 would establish four equal seasons throughout the year for pollock and would prohibit trawling in critical habitat including the SCA and waters around Kodiak. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.2, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 2, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.2, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 2, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. The scale of change in fishing activity imposed under Alternative 2 results in marginally less disturbance which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.3 Effects of Alternative 3 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 3 does not alter the effects described under Alternative 1. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 3 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 3 would establish four equal seasons throughout the year for pollock and would prohibit trawling in critical habitat including the SCA and waters around Kodiak. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.3, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 3, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 3 would prohibit trawling from November 1 through January 20, retain winter (A/B) and fall (C/D) seasons and establish four seasons within the open Steller sea lion critical habitat zones. The SCA would be closed to fishing except for area 7 and waters around Kodiak would be closed in area 2, roughly the northern half, but not in area 3, roughly the southern half. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.3, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 3, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

The same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 3 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haulout sites. It also contains a minor reduction in TACs of less than 1% for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 3 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.4 Effects of Alternative 4 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 4 does not alter the effects described under Alternative 1. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 4 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 4 would not result in a change in the TAC levels for targeted fisheries. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.4, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 4, with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 4 establishes an A season and B season for pollock in the Bering Sea, from January 20 to June 10, and June 11 to October 31, respectively. Four seasons throughout the year would be established for pollock in the Gulf of Alaska. Area 9 of the SCA would be closed to trawling, but areas 7 and 8 would be open except for a portion restricted in the pollock A season and no CVOA trawling from June 10 to December 31. Areas around Kodiak Steller sea lion haulouts and rookeries would be closed. These changes are considered insignificant to sea otters. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.4, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 4, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 4 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 3 nm of haulout sites. It also contains a variety of schemes to reduce fisheries impacts on Steller sea lions across the GOA and Aleutian Islands. The scale of change in fishing activity imposed under Alternative 4 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.5 Effects of Alternative 5 on Sea Otters

Direct Effects - Incidental Take/Entanglement in Marine Debris (Question 1)

Alternative 5 does not alter the effects described under Alternative 1. That is, there is no significant effect. Although the levels of protection from direct effects are slightly greater than those in Alternative 1, the overall take rates are very low to begin with. The effects on sea otters under Alternative 5 are considered insignificant, with respect to incidental catch and entanglement in marine debris (Table 4.1-14).

Direct Effects – Fisheries Harvest of Prey Species (Question 2)

Alternative 5 would not result in a change in the TAC levels for targeted fisheries. However, given the minor importance of groundfish in their diet, fisheries removals are not expected to have significant effects under any of the proposed alternatives. For the reasons discussed in Section 4.1.6.5, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 5 with respect to the harvest of prey species.

Indirect Effects – Spatial and Temporal Concentrations of Fishery (Question 3)

Alternative 5 would establish four seasons in the Bering Sea pollock fishery and four seasons in the Gulf of Alaska pollock fishery. Portions of SCA areas 7 and 8 would be closed to catcher-processor pollock trawling from June 10 to December 31. These measures are not considered significant to sea otters. For the same reasons listed under Alternative 1, and for the reasons discussed in Section 4.1.6.5, given the lack of overlap between fisheries and the foraging behavior of sea otters, the effects are considered insignificant under Alternative 5, with respect to the temporal and spatial concentration of the fisheries.

Indirect Effects – Disturbance Effects (Question 4)

Regarding disturbance effects, the same general comments made under Alternative 1 apply here. That is, generally disturbance effects by groundfish fisheries on sea otters cannot be demonstrated with existing data. However, Alternative 5 restricts transit within 3 nm of 37 rookeries and prohibits fishing activities within 10 or 20 nm of 37 rookeries to trawling year-round. It also contains a reduction in TACs of 92% for pollock in the Aleutian Islands (bycatch only), which is an overall reduction of less than 1% for the groundfish TAC for pollock, Pacific cod, and Atka mackerel resulting in potential disturbance effects which are not likely to change relative to Alternative 1. Thus, the scale of change in fishing activity imposed under Alternative 5 results in marginally less disturbance, which may be beneficial for sea otters, however given that the level of disturbance established for management measures comparable to 1998 were rated as insignificant according to the significance criteria established (Table 4.1-1), measures which would result in even less disturbance than that which is insignificant are also rated as insignificant.

4.1.7.6 Summary of Effects on Sea Otters

The criteria used to determine the significance of effects on sea otters is outlined in Table 4.1-1. In cases where the criteria in Table 4.1-1 for a rating of conditionally significant positive or negative were met but not used for questions 2 and 3, these cases are discussed in the analyses of the individual alternatives above. Table 4.1-14 summarizes the effects of the alternatives on sea otters. In all cases, the direct and indirect effects of all alternatives are expected to have insignificant effects on sea otters (Table 4.1-1) because there is little spatial, temporal or dietary overlap of sea otters with groundfish fisheries.

Table 4.1-14 Summary of effects of Alternatives 1 through 5 on sea otters.

Sea Otters	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Incidental take/entanglement in marine debris	I	I	I	I	I
Harvest of prey species	I	I	I	I	I
Spatial/temporal concentration of fishery	I	I	I	I	I
Disturbance	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

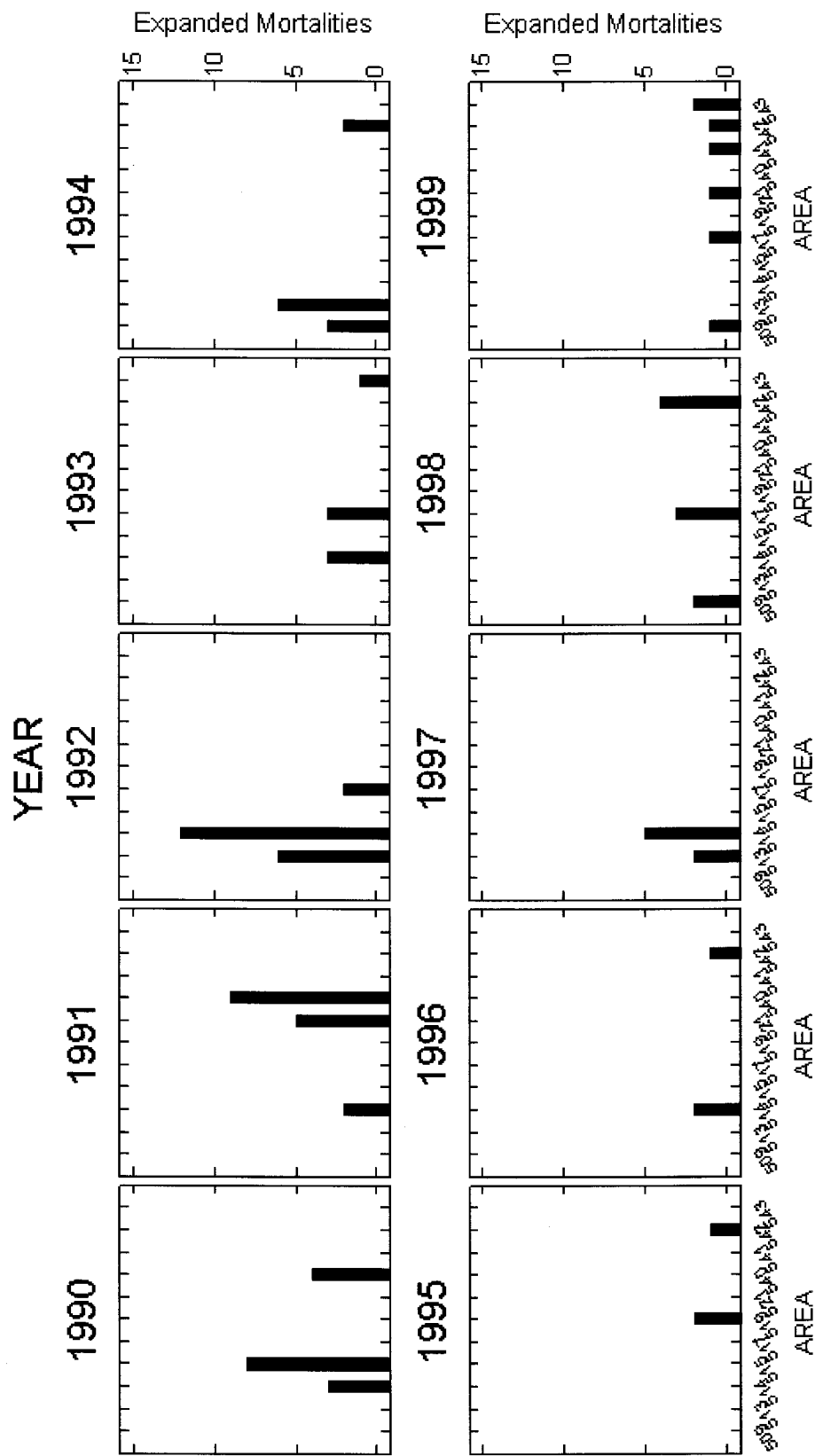


Figure 4.1-4 Distribution of Bering Sea groundfish trawl fishery incidental catch of Steller lea lions by fishery area and year, 1990-1999. Data: NMFS

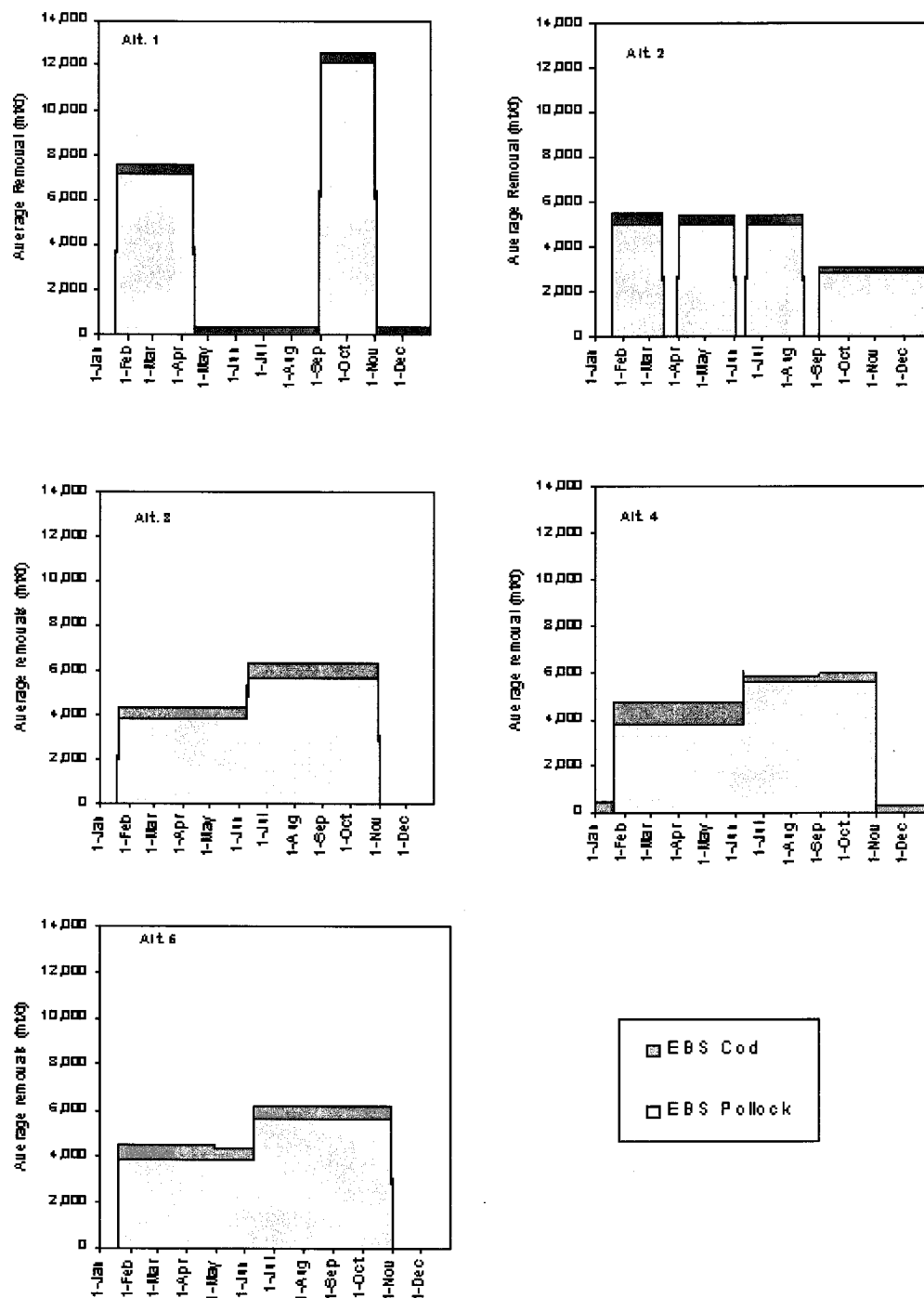


Figure 4.1-5 Projected average daily removal rates of Eastern Bering Sea pollock and Pacific cod for each Alternative.

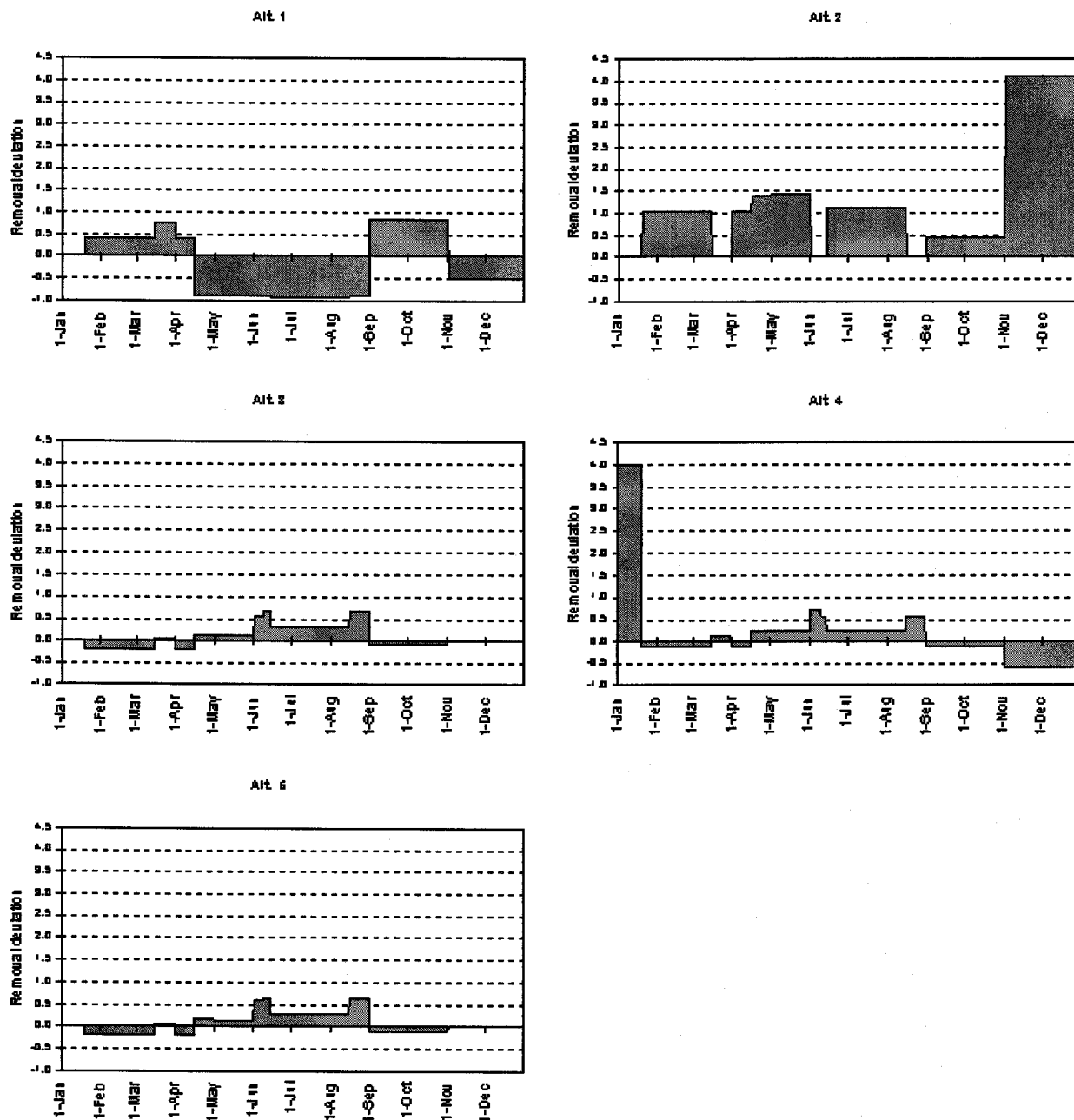


Figure 4.1-6 Deviations of relative mean daily removal rates for Eastern Bering Sea pollock and Pacific cod fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

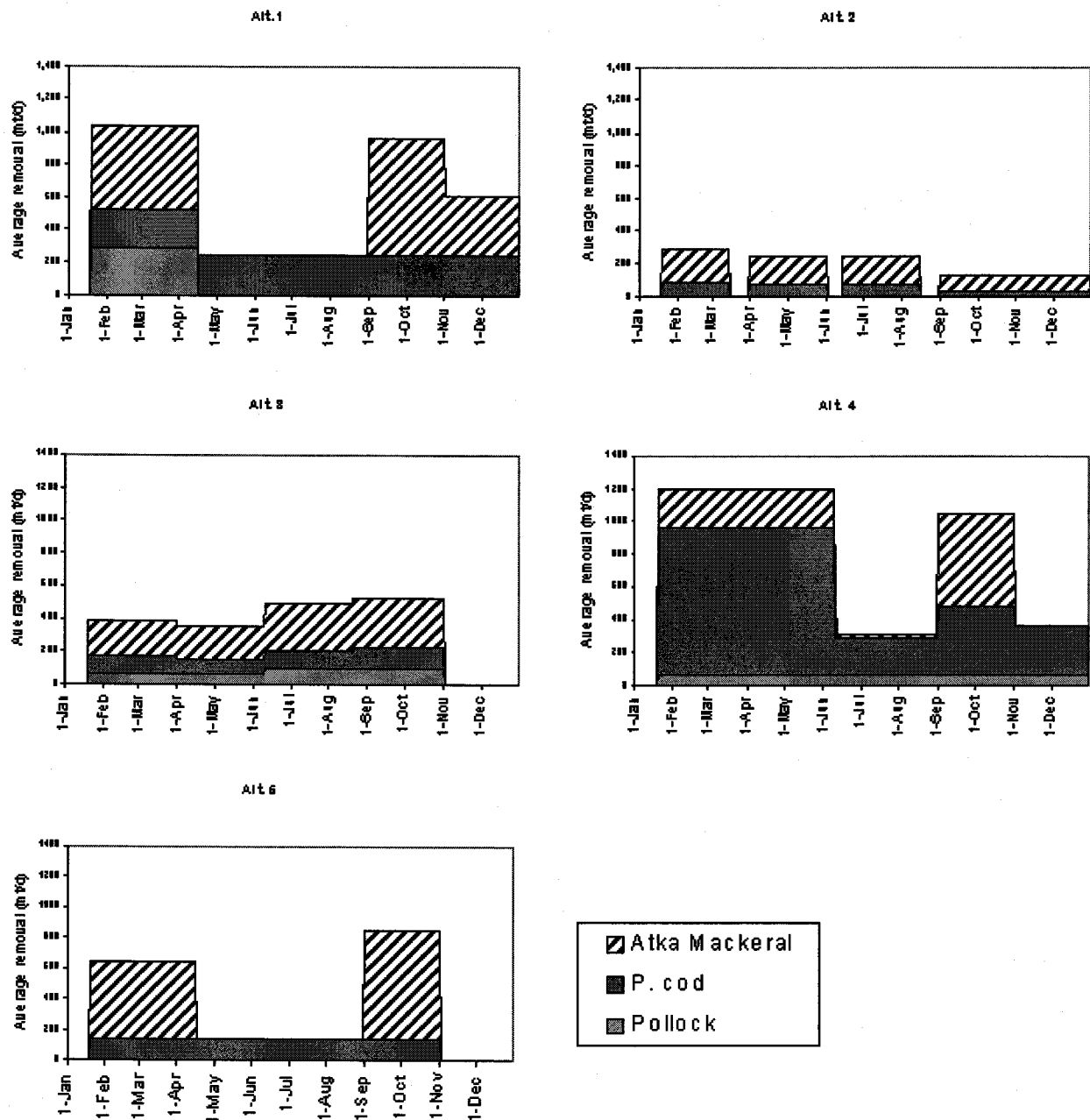


Figure 4.1-7 Projected average daily removal rates of Aleutian Island pollock, Pacific cod and Atka mackerel for each Alternative.

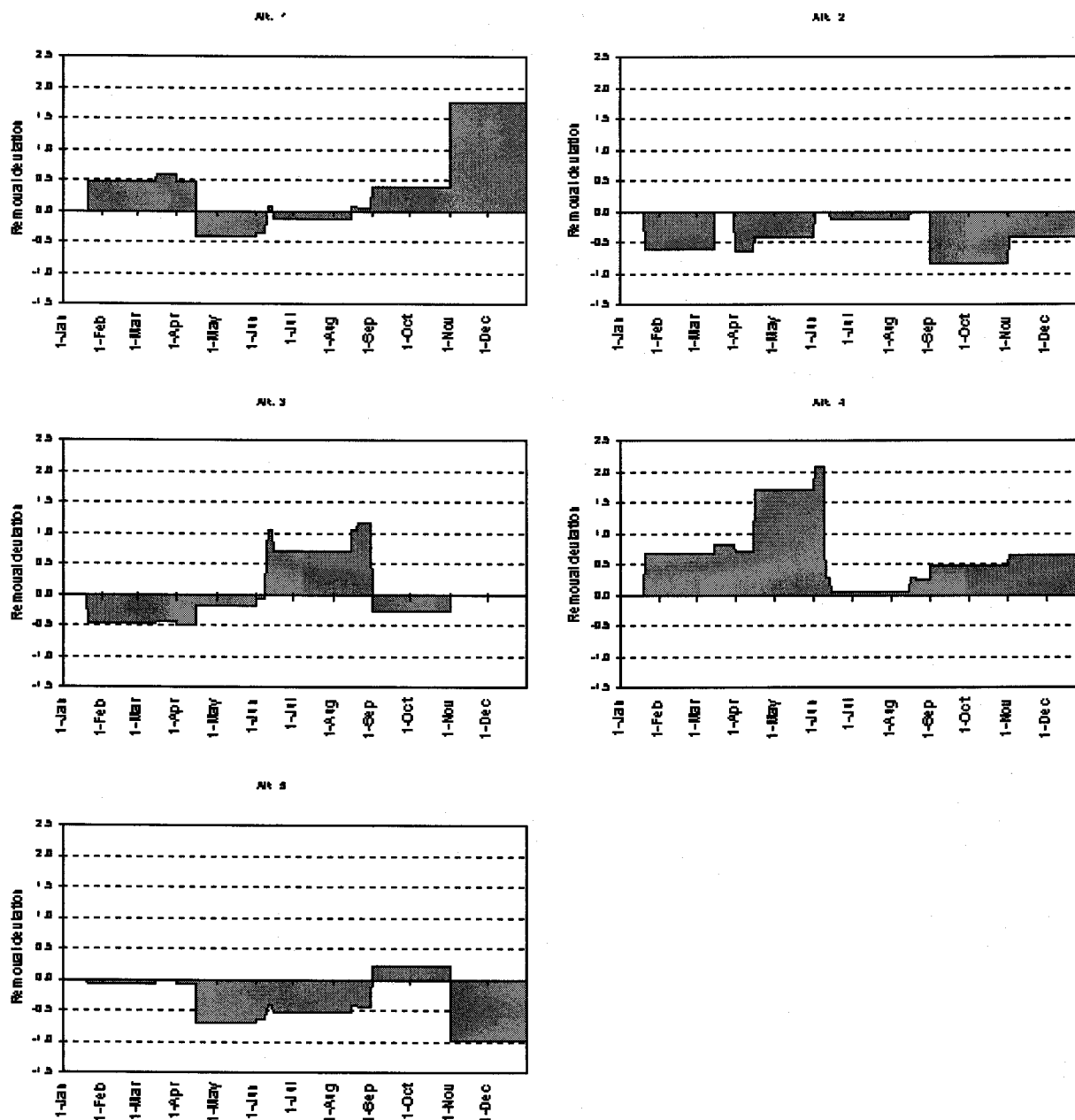


Figure 4.1-8 Deviations of relative mean daily removal rates for Aleutian Island pollock, Pacific cod and Atka mackerel fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

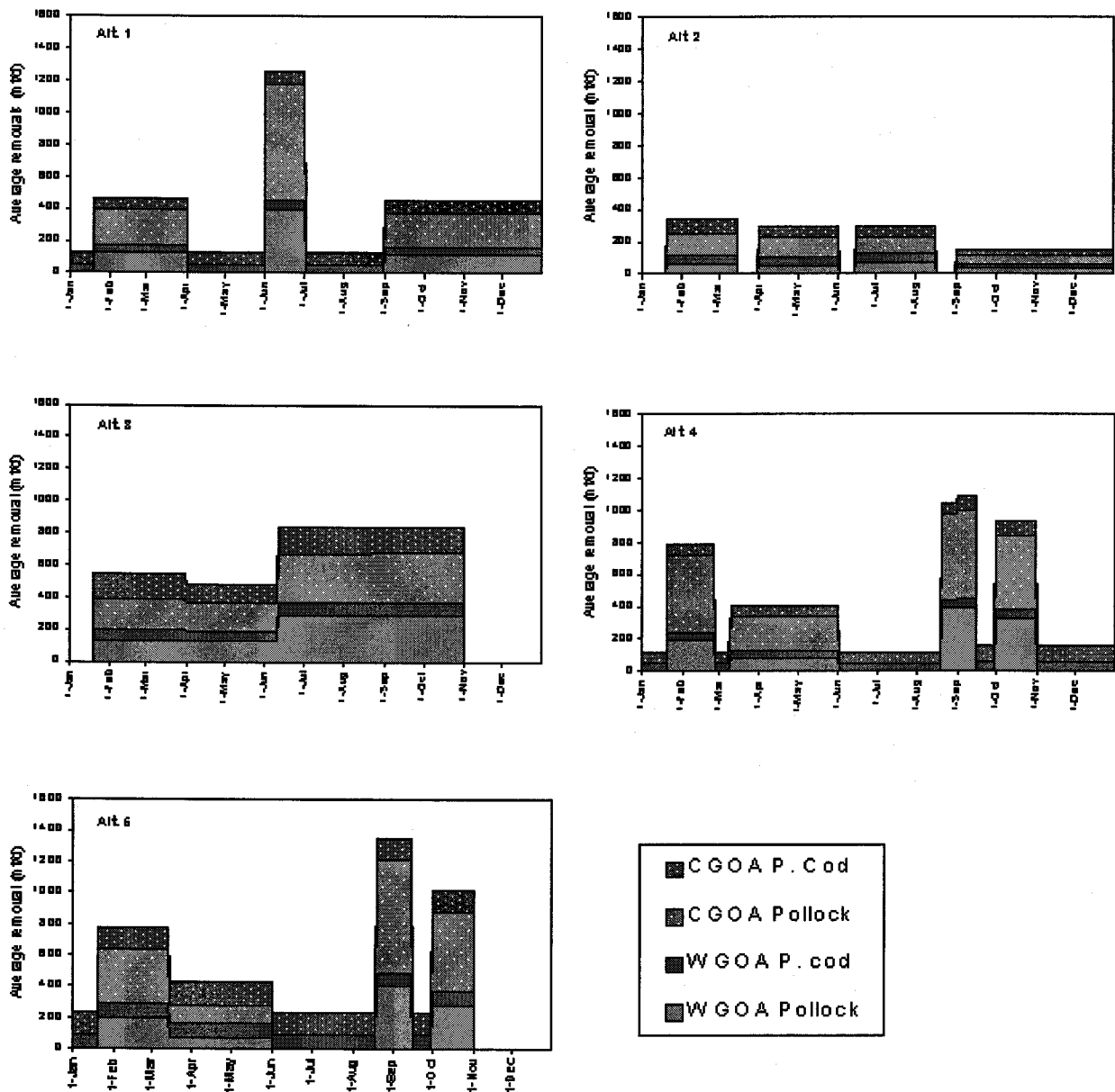


Figure 4.1-9 Projected average daily removal rates of Gulf of Alaska pollock and Pacific cod for each Alternative.

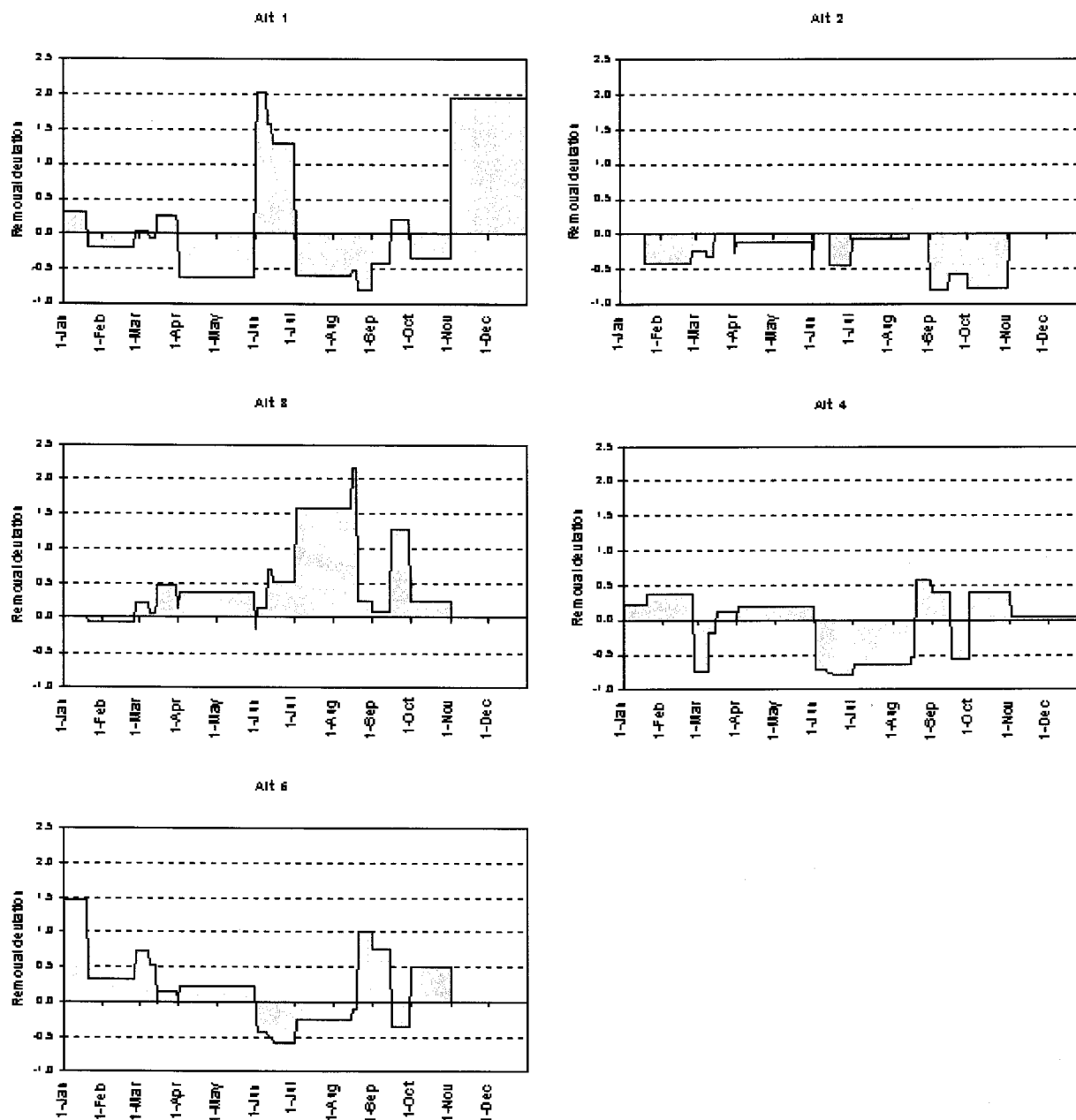


Figure 4.1-10 Deviations of relative mean daily removal rates for Gulf of Alaska pollock and Pacific cod fisheries based on projected seasonal allocation of total allowable catch for each Alternative.

Winter

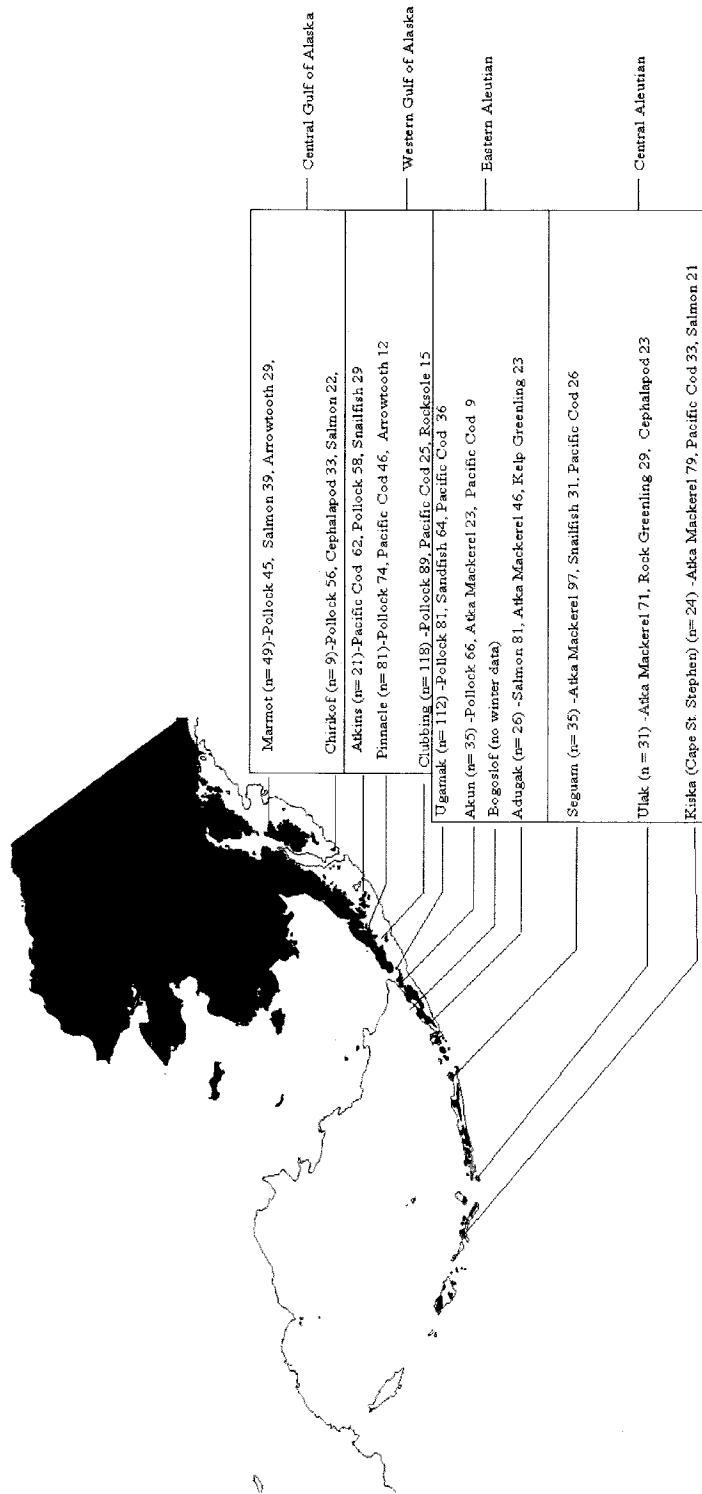


Figure 4.1-11 Percent frequency of occurrence of top three prey items found in Steller sea lion scats collected December through April, 1990-1998.

Summer

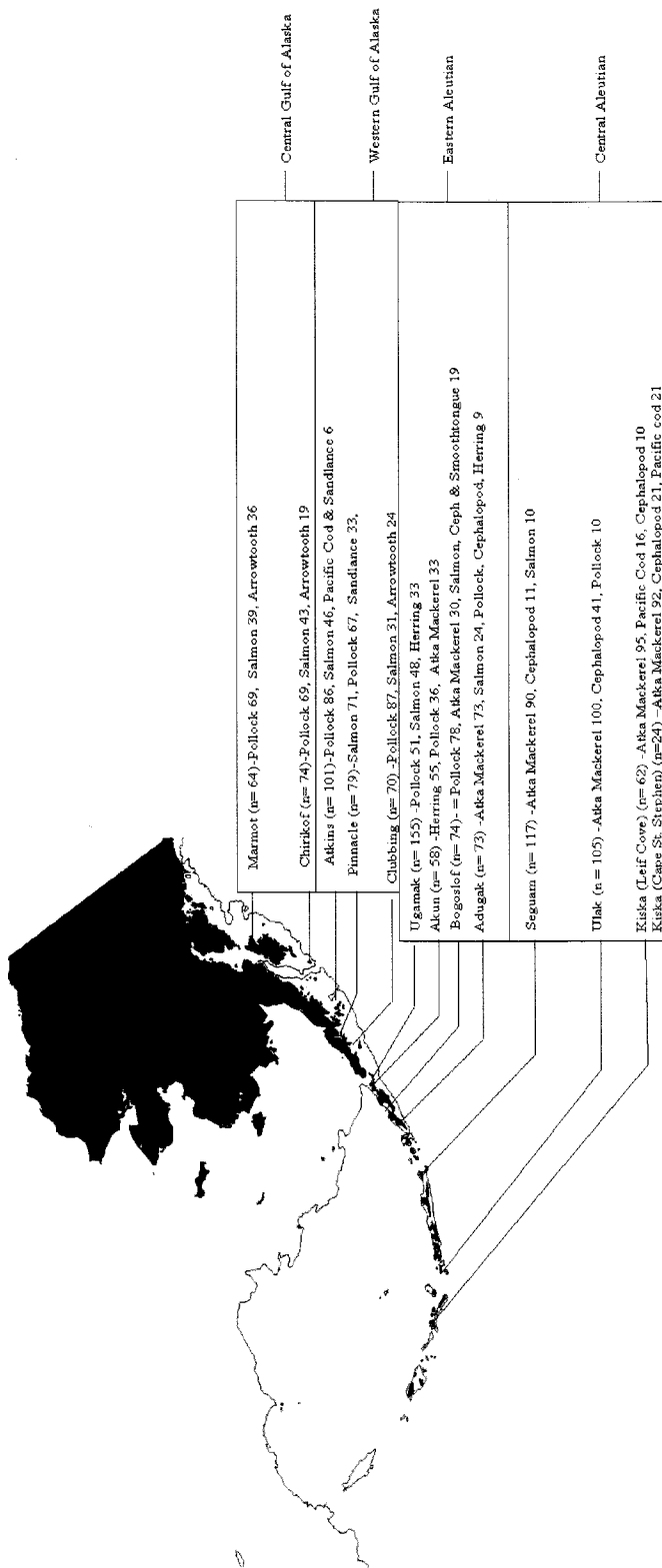


Figure 4.1-12 Percent frequency of occurrence of top three prey items found in Steller sea lion scats collected June through August, 1990-1999.

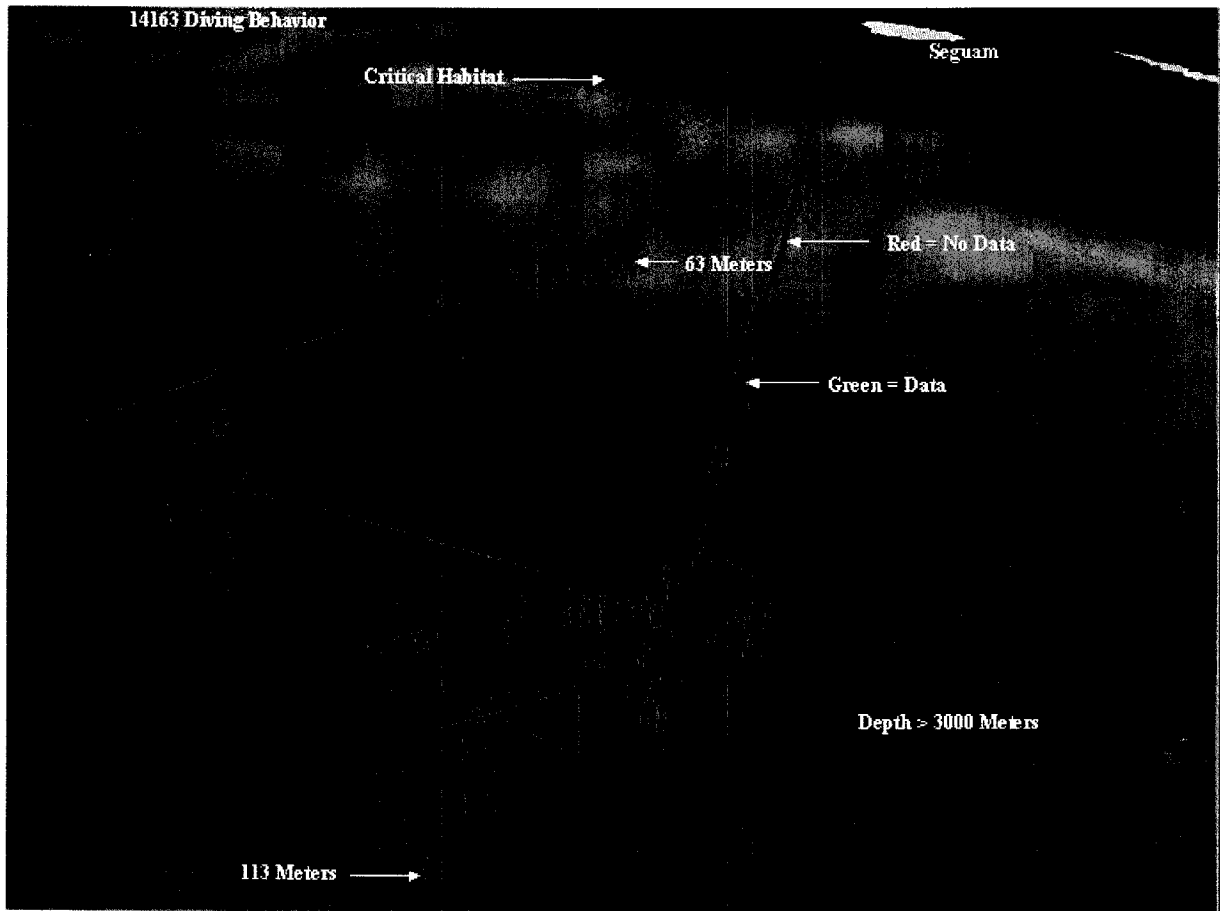


Figure 4.1-13 Three-dimensional projection of a 14.3 day long foraging trip of an 11 month old male Steller sea lion during the month of May, 2000 at Seguam Island.

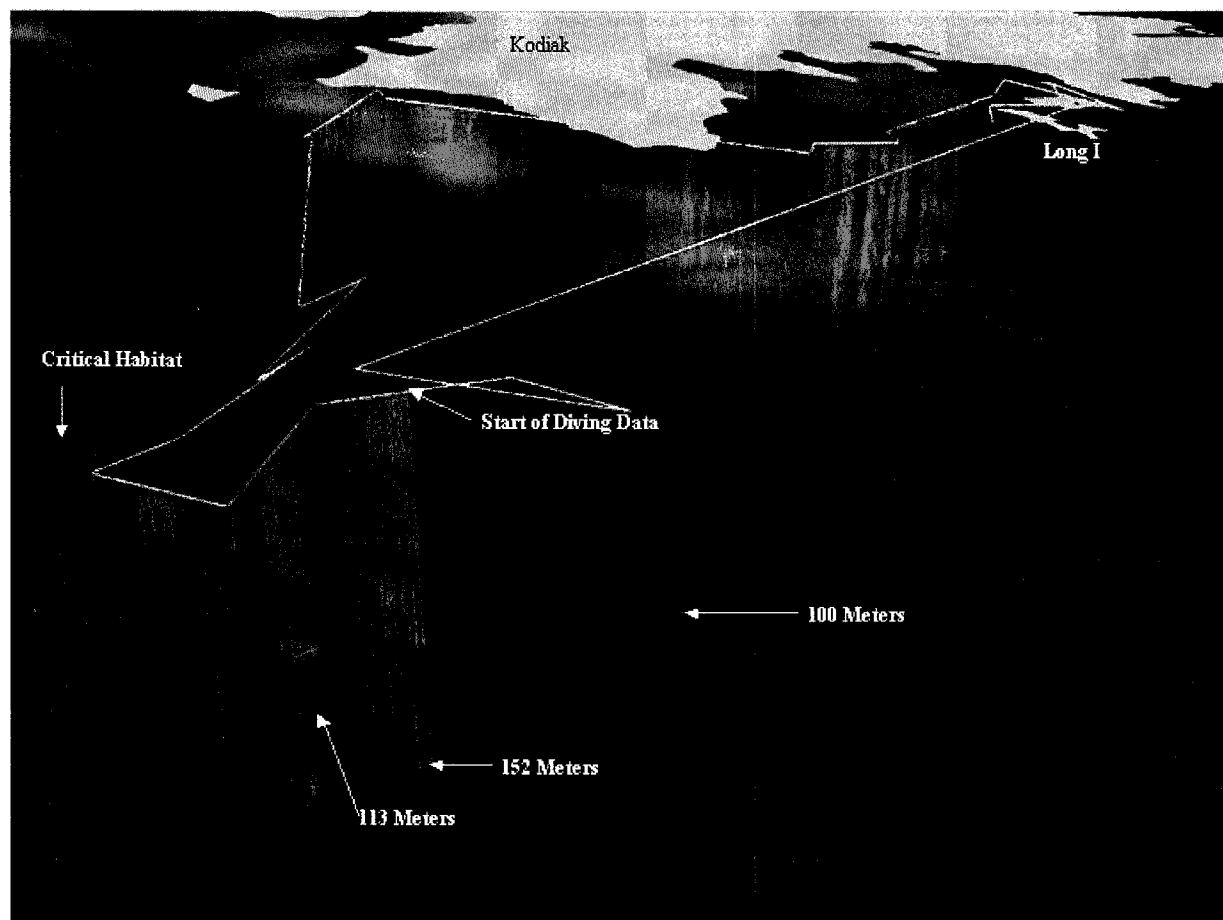


Figure 4.1-14 A 14.3 day foraging trip of an 11 month old male Steller sea lion during May 2000 at Kodiak Island.

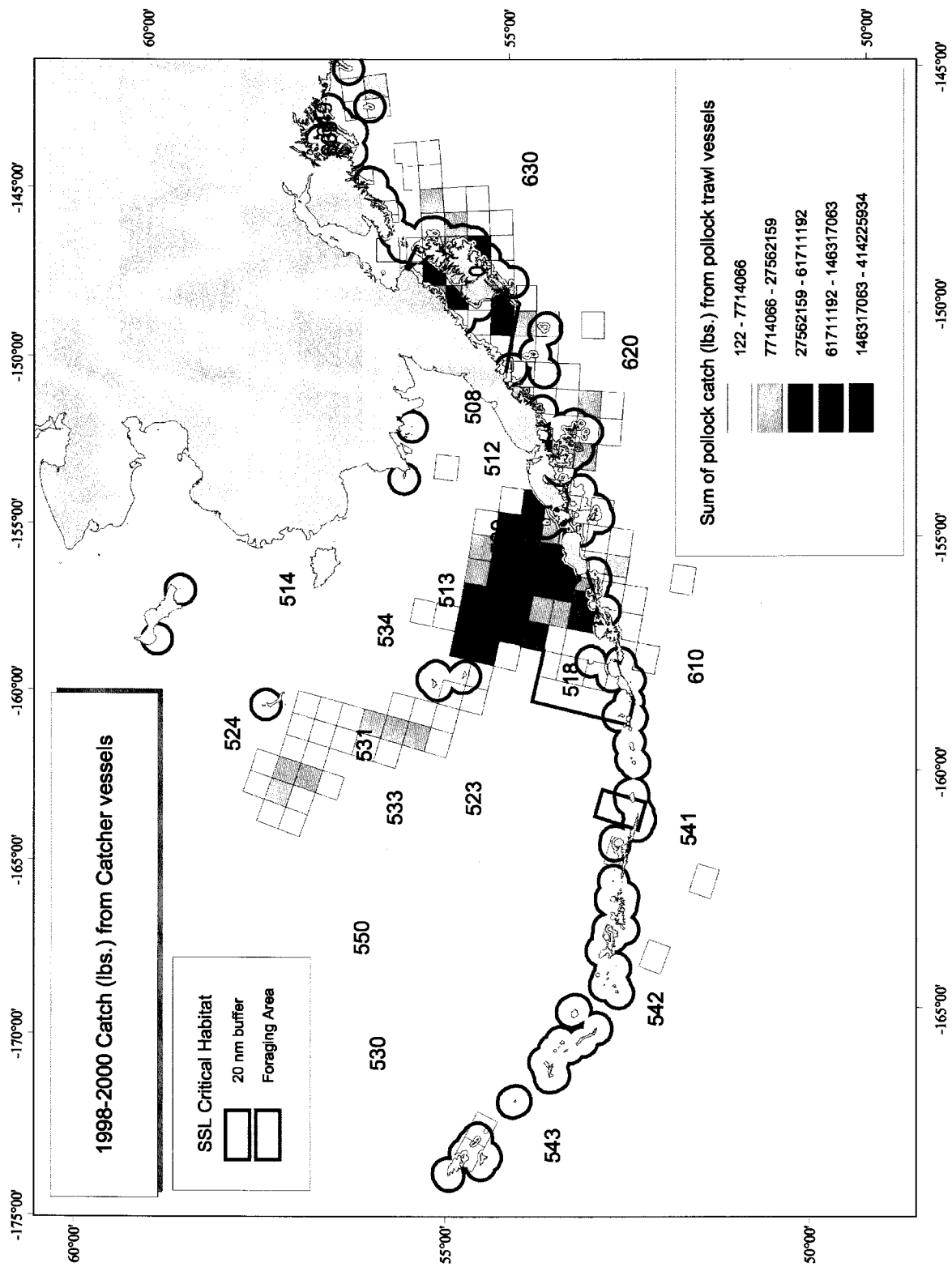


Figure 4.1-15 Regional distribution of pollock catch from catcher vessels during 1998-2000 (Source: NPFMC and NMFS).

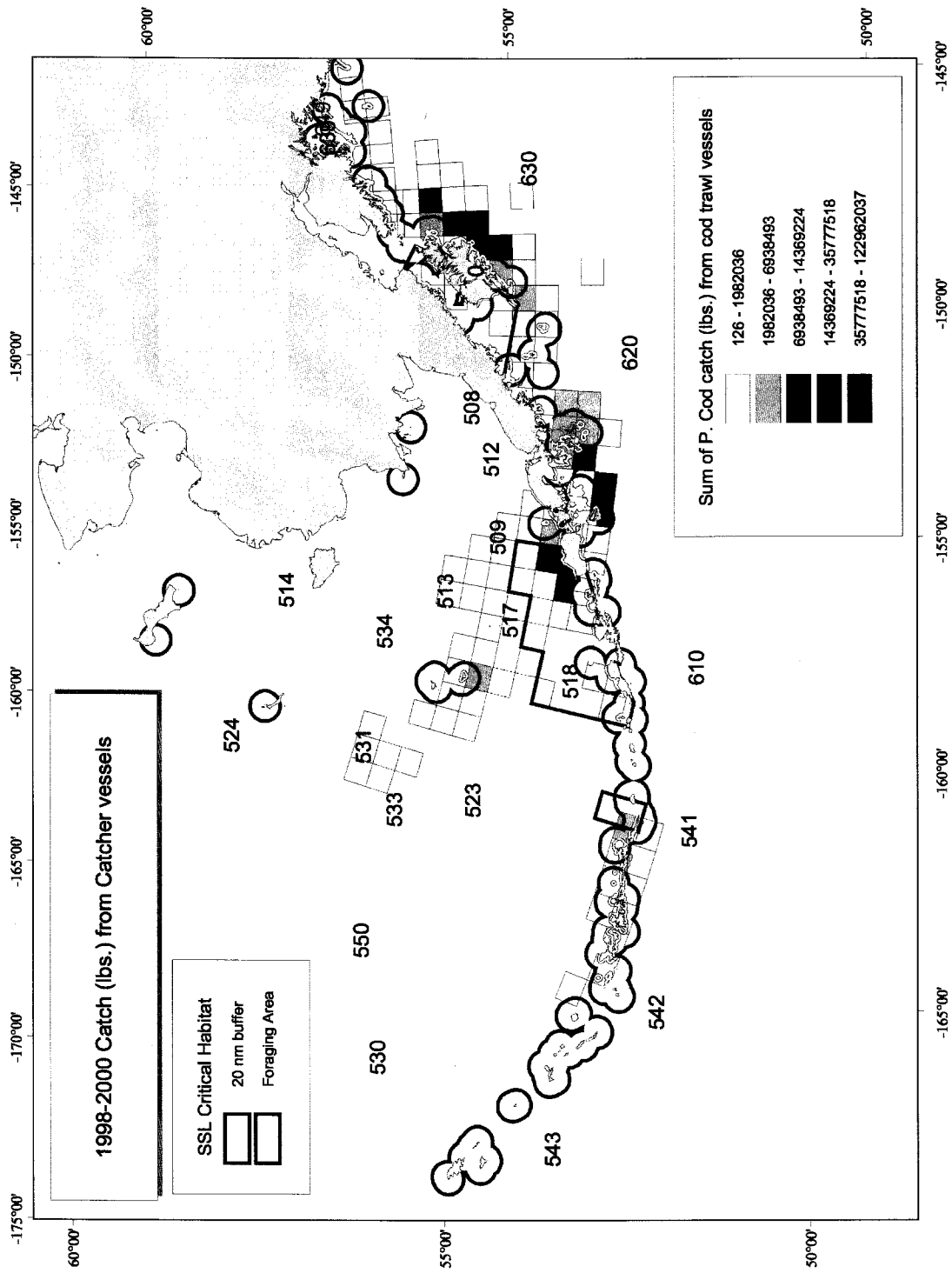


Figure 4.1-16 Regional distribution of cod catch from trawler vessels, 1998-2000 (Source: NPFMC and NMFS).

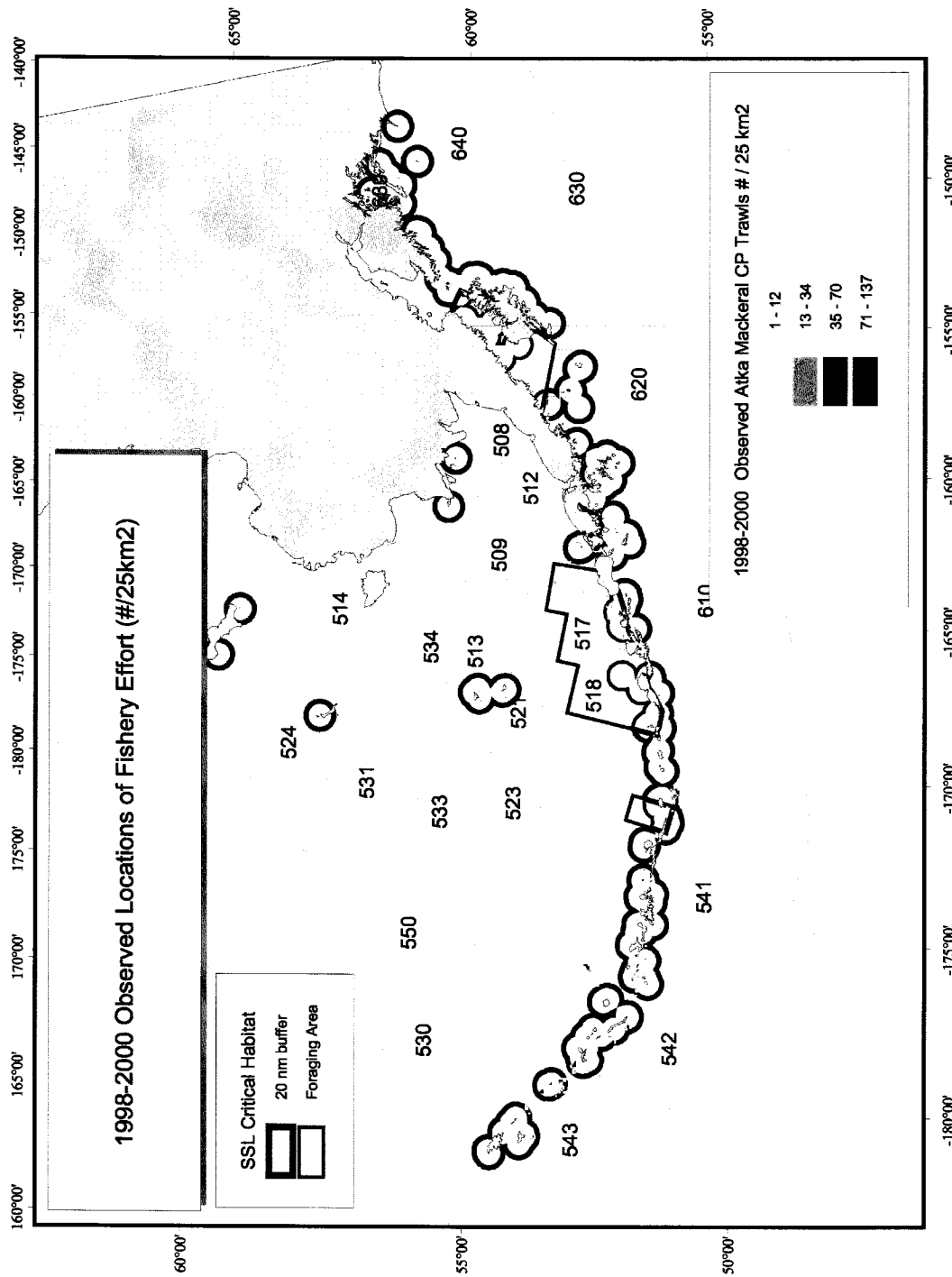


Figure 4.1-17 Regional distribution of observed Atka mackerel trawls, 1998-2000 (Source: NPFMC and NMFS).

4.2 Effects on Target Commercial Fisheries

4.2.1 Methods used for population projections under the alternatives.

Forecasting fisheries behavior is an endeavor fraught with uncertainty. Even under a relatively constant management system, changes in socio-economic and environmental conditions result in substantial future uncertainty. Add in a complex set of alternative management measures, such as those presented in this document, and the uncertainty is magnified. Nonetheless, we attempted to develop a model where certain key aspects of the current fisheries management system are considered and modified according to conditions specific management measures for the five Alternatives. It is necessary to model the likely behavior of managers, given biological information on populations and historical catch of different species by gear types and areas. In order to mimic the behavior of the complex interacting fisheries and populations in the Gulf of Alaska and Bering Sea, a generalized simulation model was implemented to represent the dynamics of the populations, the individual fisheries, their interaction and final quota allocation. The optimal decision making process (related to actual removals) was simulated using historical information on by-catch rates. The main structure of the model is presented in Figure 4.2.1-1. For several reasons, results from the model are only intended for general expectations of biomass responses given the levels of catches produced by the model.

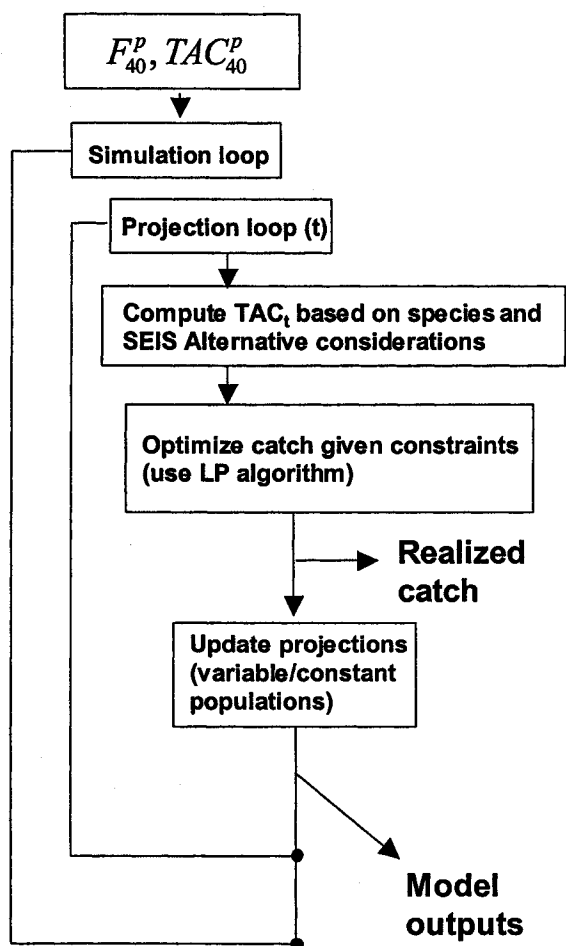


Figure 4.2-1 General description of the simulation model that calculates the optimal distribution of the catch across different fisheries subject to a set of linear constraints and bycatch datasets.

4.2.1.1 Age-structured stocks

For the stocks with age-structure information, the model is very similar to those used for the stock assessments upon which ABC recommendations are currently based, and it contains features and assumptions common to many fishery population dynamics models. Parameters and other inputs were obtained for each stock, taken directly or inferred from the most recent SAFE report or, in some cases, obtained from AFSC scientists. The simulations began with numbers at age in 2000, which were projected forward using a random recruitment simulator (Inverse Gaussian) and a fishing mortality rate defined by the alternative under consideration. Recruitments were drawn from a statistical distribution (described below) whose parameters consisted of maximum likelihood estimates obtained from the recruitments listed in the 2000 SAFE report. Recruitment estimates after 1978 were used to estimate distribution parameters. No serial correlation was assumed. The age of recruitment varied between stocks, corresponding to the minimum age used in the respective assessment models. For stock where age-structure information is not available, yet ABC's are set, the model used the most recent estimates of ABC as the upper limit on total catch.

4.2.1.2 Management Model

The analytical approach for simulating current groundfish management in the US North Pacific exclusive economic zone involves considering interactions between a large number of species, areas, and gear types. In actual practice, fisheries are managed to maximize catch subject to a number of constraints (e.g., ABCs and prohibited species caps). Management decisions are based on expectations about the array of species likely to be captured by different gear types and the cumulative effect that each individual fishery has on the allowable catch of each individual species (or species group). The expectations of capture by different fisheries are based on historical catch data of each species within area and gear strata. The ABC constraints come from stochastic projections of future stock dynamics for each individual species. Given these constraints, the predicted catch for each alternative is then computed from an inseason management model. This management model accounts for the technical multispecies-interactions of the groundfish fisheries. Finally, the predicted catches are then fed back into the age-structured information for each species (to compute the correct fishing mortality level) and projected through each year. This provides a reasonable representation of the current fisheries management practice for dealing with the multispecies nature of bycatch in target fisheries. A more detailed description of the stock projections model follows.

4.2.1.3 Alternative specific details

The projection model was designed to approximate the general patterns of catch that might be expected given the multispecies nature of groundfish fisheries. The analyses relies on two main sources of information: 1) observer and fish-ticket data; and 2) stock assessment estimates of population parameters, abundance-at-age in 2000, and recruitment variability. The first step in developing model configurations for each of the Alternatives was to process the observer bycatch data to reflect area and time closures specific to each alternative. In all cases, the baseline bycatch data was derived from observer and fishticket reports for the period 1997-1999. These data were combined in a manner so that catch could be assigned to appropriate spatial and temporal strata. If an alternative had specific areas or gears closed, then the bycatch data that fell within those categories were deleted. The notion here was simply to try to reflect how bycatch might change under alternative area-time constraints.

The second part of setting up alternative specifications involved limiting TACs either through different harvest control rules or specific ABC reductions. Figure 4.2.1-2 shows how maximum

allowable fishing mortality rates are adjusted depending on estimates of spawning biomass levels relative to the unfished state. Specifically, in Alternatives 1, 2, and 5 the TAC is set at the maximum value prescribed by the ABC control rule under Amendments 56/56 (dotted line) as modified by any alternative-specific reductions, while in Alternatives 3 and 4 the TAC is set at the maximum value prescribed by the relevant TAC control rule (dashed and solid lines, respectively). In all Alternatives, the TACs are split according to the current method of apportionment by management areas. New area management divisions proposed in this SEIS were not implemented due to the high degree of variability in areas among these Alternatives, the lack of data at the appropriate resolution, and the complexity of implementing new management areas using this modeling approach.

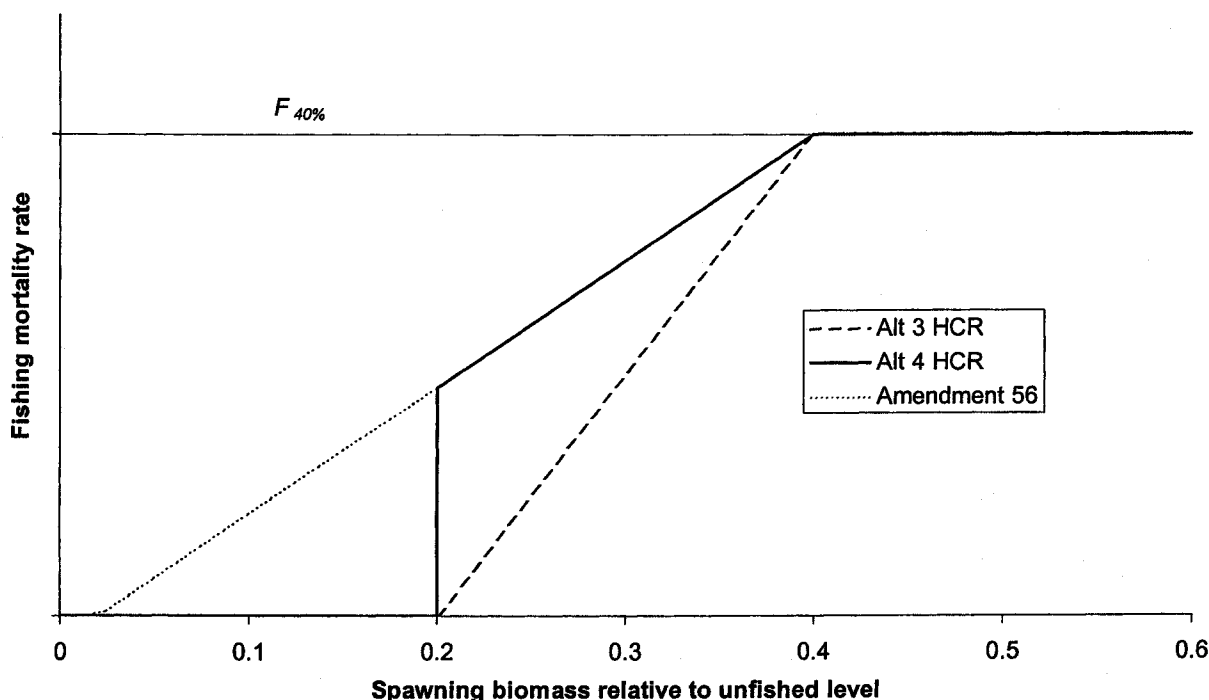


Figure 4.2.1-2. Relationship of fishing mortality rates under different harvest control rules (HCR) applied to pollock, Pacific cod, and Atka mackerel. FMP Amendments 56/56 harvest guidelines are used for Alternatives 1, 2, and 5.

4.2.1.4 Critical assumptions

For each scenario, the bycatch array is a deterministic process. That is, there is no random variability due to chance alone. For illustration, imagine that a fishery prosecuted exactly the same way in different years is likely to have different real bycatch values, even without observation error. The model was developed so that bycatch variability can be implemented but since there are only 3 years of useable data (earlier data were not available for this type of analysis) the magnitude of this uncertainty could not be assessed in the time available for this analysis.

The bycatch array is fixed over time, even if relative stock abundances change dramatically. While this is obviously a potential problem, projections over only a few years may be reasonably well approximated.

The uncertainty in current abundance levels is not modeled. The point estimates for parameter values (e.g., the numbers-at-age) in the assessments published in the 2000 SAFE are used. This greatly underestimates

the variability in the current abundance levels for all species of groundfish. Again, this is another area where the model can implement aspects to reflect this uncertainty more completely. However, the additional complexity in the presentation of the results would detract from the analysis.

We do not believe these assumptions are either equally valid for all the alternatives or valid for most of the alternatives. The complex level of interactions among changes in biomass levels, fisheries economic performance, and management effectiveness are just some of the reasons why any forecast must be viewed with a large degree of skepticism.

4.2.1.5 Projection model details

The following represents the step-by-step process of the projection model. A glossary of notation occurs at the end of this section for reference.

Step 1: Select the bycatch array appropriate for the Alternative

As presented below, separate hypothetical bycatch arrays were developed for each Alternative. A bycatch array can be simply thought of as a table where the rows represent a specific fishery (defined by target species, area, and gear type) and the columns represent the catch by species group or stock. Since the alternative specification required omitting some data from consideration (i.e., if a specific area was closed) all bycatch arrays were expanded by a single factor so that the total catch equaled the catch observed in 2000.

Step 2: Project recruitments for all years and simulations

Recruitment estimates for the years 1978-1999 (or the largest available subset thereof) were obtained from the respective 2000 stock assessments. For each stock, these recruitments were used to find maximum likelihood estimates for the inverse Gaussian distribution parameters. The distribution was parameterized such that one of the parameters represented the distribution mean. A recruitment projection was obtained for each year and simulation by drawing randomly from this parametric distribution, with the following exception. For 2000, the parameter representing the distribution mean was replaced with the 1999 stock assessment's estimate of recruitment in 2000.

Step 3: Estimate actual fishing mortality rates for the initial year

The steps in this part of the model were as described below. Because the alternatives were assumed not to take effect until after 2000, these steps were conducted only once, rather than separately for all eight alternatives. Compute the fishing mortality rate that would set catch equal to C_t by solving the following implicit equation:

$$C_t = F_t \sum_{a=1}^{n_{age}} \left[N_{a,t} \left(\frac{1 - \exp \left(-M_a - F_t \sum_{g=1}^{n_{year}} s_{a,g} d_g \right)}{M_a + F_t \sum_{g=1}^{n_{year}} s_{a,g} d_g} \right) \sum_{g=1}^{n_{year}} w_{a,g} s_{a,g} d_g \right]$$

Step 4: Project Numbers at Age for All Ages, Years, and Simulations

For each Alternative, over 1,000 simulations, future numbers at age were projected in each year based on a feedback from the linear programming constrained optimization algorithm (hereafter referred to as the LP). These projections followed the following sub-steps:

- 1) Initialize simulation index:
 $u = 0$
- 2) Increment simulation index:

$$u = u + 1$$

3) Initialize time index:

$$t = 1$$

4) Compute numbers at age for initial year of simulation u :

For $a=1$,

$$N_{a,t,u} = R_{t,u}$$

For $1 < a_{nage}$,

$$N_{a,t,u} = n_a$$

5) Set fishing mortality rate for initial year of simulation u :

$$F_{t,u} = F_{00}$$

6) Increment time index:

$$t = t + 1$$

7) Compute numbers at age in year t of simulation u :

For $a=1$,

$$N_{a,t,u} = R_{t,u}$$

For $1 < a < nage$,

For $a=nage$,

$$N_{a,t,u} = N_{a,t-1,u} \exp \left(-M_a - F_{t-1,u} \sum_{g=1}^{n_{gear}} s_{a,g} d_g \right) + N_{a-1,t-1,u} \exp \left(-M_{a-1} - F_{t-1,u} \sum_{g=1}^{n_{gear}} s_{a-1,g} d_g \right)$$

8) Compute the actual catch given constraints in LP fishing mortality rate X that would set catch equal to $C_{t,u}$ in year t of simulation u (as estimated from the multispecies management constrained optimization problem described below and varies by alternative) by solving the following implicit equation:

$$C_{t,u} = X_{t,u} \sum_{a=1}^{nage} \left(N_{a,t,u} \left(\frac{1 - \exp \left(-M_a - X_{t,u} \sum_{g=1}^{n_{gear}} s_{a,g} d_g \right)}{M_a + X_{t,u} \sum_{g=1}^{n_{gear}} s_{a,g} d_g} \right) \sum_{g=1}^{n_{gear}} w_{a,g} s_{a,g} d_g \right)$$

9) Compute spawning biomass in year t of simulation u :

$$B_{t,u} = p \sum_{a=1}^{nage} N_{a,t,u} m_a w_{a,l+n_{gear}}$$

10) Compute the fishing mortality rate for year t of simulation u :

The appropriate fishing mortality rate was determined by the projection year and the relative spawning biomass of the stock as shown in the table below (B_{ref} corresponds to B40% in all cases. F_{ref} correspond to F40% in all cases unless alternative lower rates are regularly recommended in the management).

Alternatives 1, 2, and 5 ($\alpha=0.05$):

Relative spawning biomass	Fishing mortality rate
$B_{t,u} < \alpha B_{ref}$	$F_{t,u} = 0$
$\alpha B_{ref} \leq B_{t,u} < B_{ref}$	$F_{t,u} = \min \left(X_{t,u}, F_{ref} \left(\frac{B_{t,u}}{B_{ref}} - \alpha \right) / (1 - \alpha) \right)$
$B_{ref} \leq B_{t,u}$	$F_{t,u} = \min (X_{t,u}, F_{ref})$

Alternative 3 ($\alpha=0.5$):

Relative spawning biomass	Fishing mortality rate
$B_{t,u} < \alpha B_{ref}$	$F_{t,u} = 0$
$\alpha B_{ref} \leq B_{t,u} < B_{ref}$	$F_{t,u} = \min \left(X_{t,u}, F_{ref} \left(\frac{B_{t,u}}{B_{ref}} - \alpha \right) / (1 - \alpha) \right)$
$B_{ref} \leq B_{t,u}$	$F_{t,u} = \min (X_{t,u}, F_{ref})$

Alternative 4 ($\alpha=0.05$):

Relative spawning biomass	Fishing mortality rate
$B_{t,u} < 0.5 B_{ref}$	$F_{t,u} = 0$
$\alpha B_{ref} \leq B_{t,u} < B_{ref}$	$F_{t,u} = \min \left(X_{t,u}, F_{ref} \left(\frac{B_{t,u}}{B_{ref}} - \alpha \right) / (1 - \alpha) \right)$
$B_{ref} \leq B_{t,u}$	$F_{t,u} = \min (X_{t,u}, F_{ref})$

11) Check to see if all years of simulation u have been completed, then continue as necessary:

If $t < n_{pro} + 1$, return to 6)

If $t = n_{pro} + 1$, end simulation u .

12) Check to see if all simulations have been completed, then continue as necessary:

If $u < n_{smp}$, return to 2).

If $u = n_{smp}$, end of simulations.

Step 5: Compute measures of stock performance from the above projections

The steps in this part of the model were as described below, and were conducted separately for all five alternatives.

Compute total biomass in each year and simulation:

$$T_{t,u} = \sum_{a=1}^{n_{age}} N_{a,t,u} w_{a,l+n_{gear}}$$

Compute spawning biomass in each year and simulation:

$$B_{t,u} = p \sum_{a=1}^{n_{age}} N_{a,t,u} m_a w_{a,l+n_{gear}}$$

Compute catch in each year and simulation:

$$C_{t,u} = F_{t,u} \sum_{a=1}^{n_{age}} \left(N_{a,t,u} \left(\frac{1 - \exp \left(- M_a - F_{t,u} \sum_{g=1}^{n_{gear}} s_{a,g} d_g \right)}{M_a + F_{t,u} \sum_{g=1}^{n_{gear}} s_{a,g} d_g} \right) \sum_{g=1}^{n_{gear}} w_{a,g} s_{a,g} d_g \right)$$

Compute average age in final projection year across all simulations:

$$A = n_{sims}^{-1} \sum_{u=1}^{n_{sims}} \frac{\sum_{a=1}^{n_{age}} a N_{a,l+n_{pro},u}}{\sum_{a=1}^{n_{age}} N_{a,l+n_{pro},u}} + a_{min} - 1$$

4.2.1.6 The Linear programming algorithm

Linear programming is an active research branch of operation research that has proved to be useful in resource management. In this context an optimization problem is considered a linear one if all the objective function and constraint coefficients can be arranged in a linear way. The linear optimization problem in this case, consists of finding the optimal catch allocation in order to maximize the overall catch or total revenue across all fisheries and subjected to a certain number of linear constraints. We used a revised Simplex algorithm (Press et al, 1992) to find the optimal vertex in this multidimensional space.

The objective function and constraint coefficients were computed primarily from the NMFS Region Blend dataset. It was averaged over the period 1997 and 1999, so all the coefficients represent averages from this time period. Five types of constraints were conceived for both systems (GOA/BSAI), namely TAC constraints for each FMP/AREA complex, special gear constraint for some species, lower and upper bound constraints on the variation of catch relative to 1999 levels for each fishery, and constraints of the maximum allowable biological removals of each system. In the following section we present how each coefficient was computed from the blend dataset.

4.2.1.7 Objective function coefficients

The target function consisted of coefficients derived from the blend data set for Fisheries Management Plan species across different fisheries. They represent the average revenue of each fishery that has species under the FMP. The coefficients remained the same over the forward simulation time-stages and were computed using the following equation:

$$A_g = \left(\sum_{j=1}^{n_{FMP}} \sum_{k=1}^{n_{AREAs}} P_j C_{j,k,g}^{bl} \right)$$

where

$$\Theta_i = \sum_{g=1}^{n_{Fsh}} [A_g Y_{i,g}]$$

A_g : Objective function coefficients (computed from the BLEND dataset).

$C_{j,k,g}^{bl}$: Catch data from the BLEND dataset by species, sub-area and fishery.

$Y_{i,g}$: Relative total catch between fisheries within each year.

P_j : Relative price of FMP species with respect to Pollock (?), do not vary with year.

i : Year

j : FMP species

k : Sub-area

h : Species

g : Fishery

4.2.1.8 Linear Constraints

In our optimization problem we allowed for two types of constraints, less than or equal (LE) and greater than or equal (GE). We considered five types of LE and one type of GE constraints (they are listed below in consecutive order). All the constraints were constructed based on the BLEND data set and represent a variety of restrictions imposed to the optimization problem. The coefficients did not change over time and were computed therefore only once during the simulation for a specific Alternative.

The bounds were based on several sources of information, but in only 2 cases (constraints types 1 and 3) they changed over time.

Acceptable Biological Catch (ABC) (TAC constraints).

These constraints determined an upper bound equivalent to the TAC for each species in each sub-area. Each constraint has one coefficient and represents the average annual catch by FMP species and area as:

$$\sum_{g=1}^{n_{Fsh}} a_{j,k,g}^{ABC} \leq b_{j,k}^{ABC_i}$$

$$a_{j,k,g}^{ABC} = C_{j,k,g}^{bl}$$

where

$$b_{j,k}^{ABC_i} = TAC_{i,j,k} f_k$$

$TAC_{i,j,k}$ = Total allowable catch for species j , in sub-area k in year i and f_k is the split by area for a particular species and the bounds of the constraints are calculated as a function of a fixed allocation fraction of the TAC across sub-areas and the estimates TAC by year.

Market constraints (MC)

The model allows for market considerations to be factored in that affect maximum catches by

$$\sum_{g=1}^{n_{Fsh}} a_g^{MC_i} \leq b^{MC_i}$$

$$a_g^{MC} = \sum_{d=1}^{n_{Mkt}} \sum_{k=1}^{n_{Areas}} C_{d,k,g}^{bl}$$

d = species subjected to market constraints.

$$b^{MC}$$

Bound of species subjected to market constraints relative to the average for 1997-1999. Note that market constraints were not used in this analysis.

Gear type (G) constraints

The model was established to have rudimentary gear allocations for a specific TAC. This constraint was specified as

$$\sum_{g=1}^{n_{Fsh}} a_g^{G_i} \leq b^{G_i}$$

$$a_g^{G_i} = \sum_{k=1}^{n_{Areas}} C_{k,g}^{bl}$$

$$b^{G_i} = TAC_b f_{k,gr}^{G_i}$$

b = species with gear restrictions

gr = gear type

$$f_{k,gr}^{G_i}$$

: proportion of each gear type of each species.

Upper limit constraints on relative catch by FMP species (UL)*

This way the relative catch does not go to heaven

$$a_g^{UL_i} \leq b_g^{UL_i}$$

$a_g^{UL_i}$ is a scalar

Overall Optimum Yield (OY) constraint

The specification that the OY cap could not be exceeded was given as:

$$\sum_{g=1}^{n_{Fsh}} a_g^{OY} \leq b^{OY}$$

$$a_g^{OY_i} = \sum_{e=1}^{n_{sp}} \sum_{k=1}^{n_{Areas}} C_{e,k,g}^{bl}$$

$$b^{OY} = OY$$

OY = optimum yield in all the entire geographical area (Including all species)

e = species that account for optimum yield

Lower limit constraints on relative catch by FMP species

Based on extensive initial runs of this model, the optimal solution often eliminated a number of fisheries. To prevent this and to ensure that the catch remains positive, the following set of lower-limit constraints were applied.

$$a_g^{LL_1} \geq b_g^{LL_1}$$

$a_g^{UL_1}$ is a scalar for fishery g .

Finding the optimum solution

The 4 types of constraints do not vary from year to year, only the once related to TAC change.

* upper limit constraints

* lower limit constraint

Following the standard tableau notation we can reduce the system of equations to the following matrix:

$$\begin{bmatrix} 0 & A_1 & \cdots & A_i & \cdots & A_g \\ b_{i,j,k}^{ABC_1} & -a_{j,k,1}^{ABC_1} & \cdots & a_{j,k,i}^{ABC_1} & \cdots & a_{j,k,g}^{ABC_1} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b_{i,j,k}^{ABC_{mABC}} & -a_{j,k,1}^{ABC_{mABC}} & \cdots & -a_{j,k,i}^{ABC_{mABC}} & \cdots & -a_{j,k,g}^{ABC_{mABC}} \\ b^{MC_1} & -a_1^{MC_1} & \cdots & -a_i^{MC_1} & \cdots & -a_g^{MC_1} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b^{MC_{mMC}} & -a_1^{MC_{mMC}} & \cdots & -a_i^{MC_{mMC}} & \cdots & -a_g^{MC_{mMC}} \\ b^{G_1} & -a_1^{G_1} & \cdots & -a_i^{G_1} & \cdots & -a_g^{G_1} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b^{G_{mG}} & -a_1^{G_{mG}} & \cdots & -a_i^{G_{mG}} & \cdots & -a_g^{G_{mG}} \\ b^{UL_1} & -a_1^{UL_1} & 0 & 0 & 0 & 0 \\ \vdots & 0 & 0 & -a_i^{UL_{n_1}} & 0 & 0 \\ b^{UL_{nUL}} & 0 & 0 & 0 & 0 & -a_g^{UL_{nUL}} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b^{OY} & -a_1^{OY} & \cdots & -a_i^{OY} & \cdots & -a_g^{OY} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ b^{LL_1} & -a_1^{LL_1} & 0 & 0 & 0 & 0 \\ \vdots & 0 & 0 & -a_i^{LL_{nLL}} & 0 & 0 \\ b^{LL_{nLL}} & 0 & 0 & 0 & 0 & -a_g^{LL_{nLL}} \end{bmatrix}$$

m_{ABC} : Number of ABC type of constraints (number of species that have TAC)

m_{MC} : Number of market constraints (not used for this analysis).

m_G : Number of gear type of constraints

m_{UL} : Number of upper limit constraints on relative catch of FMP species.

m_{OY} : Number of overall yield constraints (only one).

m_{LL} : Number of upper limit constraints on relative catch of FMP species.

where A_i are the objective function coefficients, b^j is the bound of constraint j and a_i^j the constraint coefficients of fishery i and constraint j . Some of the coefficients (A_i, a_i^j) are zero but they are presented here in a general notation.

4.2.1.9 Methods used to estimate the 1997-99 bycatch arrays

We used the NMFS Alaska Region blend estimates of catch by area, species, gear, and target species combined with observer fishticket (landing receipts recorded by ADFG statistical areas) data.

The North Pacific Groundfish Observer Program currently provides all of the information we have on fishery interactions with non-target species. Observers estimate total catch and species composition of the catch in a random sample of hauls. All animals are counted, weighed, and identified to the lowest practical taxonomic level, regardless of their status as a target species, or whether they will later be discarded by the vessel. The Observer program is extensive, covering the majority of fishing effort in the BSAI and up to 30% of fishing effort in the GOA.

Despite the large size and extent of the Observer Program, not all fishing is observed at all times; only fishing vessels over 124 ft in length must carry an observer for all days fishing. Smaller vessels (60-124 ft) are only required to carry an observer for 30% of days fishing, and vessels under 60 ft are never required to carry an observer. Therefore, we had to extrapolate the data collected by observers to the reported catch from all (observed + unobserved) fishing in order to estimate the total catches of non-target species groups from all fishing for this analysis. This assumes that observed fishing and unobserved fishing have the same catch composition. Although this assumption is unverified, observer data is the best (and only) source of information on non-target species catch, so we use it.

Catches were estimated by species group for the recent domestic fishery, 1997 - 1999, using the following method: within each year, each vessel's observed catch of a given species group was summed within statistical area, gear type, and week. A target fishery was then assigned to each vessel's weekly catch, generally by assuming that the species with the highest retained catch for that week was the target species (the PSEIS describes target fishery designations and the specific algorithm for assigning targets). This is consistent with target assignments done as part of the inseason management system at the regional office. Catch by species (target and non-target, where available) was then summed for each year over all observed vessels within each area, gear, and target fishery. The ratio of observed non-target species group catch to observed target species catch within each area, gear, and target fishery was multiplied by the total reported (regional office blend-estimated) target species catch within that area, gear, and target fishery. Data from years prior to 1997 could not be assigned to target fisheries in a way which is consistent with total catch targets assigned by the Regional office due to changes in the structure of the observer database. We do not consider this a problem because the most recent years of catch information are most valuable for the purposes of this analysis. Catches of Other species, Forage fish, and grenadiers were estimated for 1990 through 1999 as part of the annual stock assessment process and are reported in annual SAFE documents for the BSAI and the GOA.

These bycatch data were processed to reflect area and time closures specific to each alternative. Because the bycatch estimates were assigned to spatial and temporal strata, the effect of changes in management measures could be reflected by modifying the bycatch arrays accordingly. For example, if an alternative had specific closed areas, then the bycatch data that fell within those categories were deleted. The notion here was simply to try to reflect how bycatch might change under alternative area-time constraints.

Glossary of symbols used in description of the model

Dimensions

a_{max}	maximum age used in the model (plus group)
a_{min}	minimum age used in the model
n_{age}	number of ages in the model
n_{gear}	number of gear types for which separate selectivity schedules are used
n_{pro}	number of years to project beyond the initial year in each simulation
n_{smp}	number of simulations

Indices

a	relative age index, $1 \leq a \leq n_{age}$
g	gear index, $1 \leq g \leq n_{gear}$
t	projection year index, $1 \leq t \leq n_{pro}$
u	simulation index, $1 \leq u \leq n_{smp}$

Life History and Fishery Parameters

d_g	proportion of total instantaneous fishing mortality rate distributed to gear g
M_a	natural mortality rate at age a
m_a	proportion of age a fish that are mature
p	proportion of the population consisting of females
$s_{a,g}$	selectivity of gear type g for fish of age a (scaled so that $\max(s)=1$)
$w_{a,g}$	weight of age a fish as sampled by gear g ($w_{a,1+n_{gear}}$ represents age a weight in the population)

Other Parameters and Expressions Used in Projections

B_{ref}	a parameter of the control rules used to set the overfishing rate and to constrain F_{ABC}
$B_{t,u}$	spawning biomass in projection year t of simulation u
C_{2000}	actual catch observed in 2000 (or projected to be caught)
$C_{t,u}$	catch in projection year t of simulation u
$F_{t,u}$	fishing mortality rate in projection year t of simulation u
F_{lim}	a parameter of the control rule used to set the overfishing rate
F_{ref}	a parameter of the control rule used to constrain F_{ABC}
$N_{a,t}$	numbers at age a in projection year t
$N_{a,t,u}$	numbers at age a in projection year t of simulation u
n_a	numbers at age a in 2000
$O_{t,u}$	rate of fishing mortality that constitutes overfishing in projection year t of simulation u
P	probability of overfishing in at least one year of the projection period
R_{01}	recruitment for 2001 projected in the 2000 stock assessment
$R_{t,u}$	recruitment in projection year t of simulation u
$T_{t,u}$	total biomass (between ages a_{min} and a_{max}) in projection year t of simulation u
TAC_{00}	TAC actually specified for 2000
$X_{t,u}$	fishing mortality rate that sets catch in projection year t of simulation u equal to C_{max}

4.2.2 Effects of the Alternatives on Walleye Pollock

The projected impact on average pollock yield differs between alternatives. In the Eastern Bering Sea projected average pollock yield (2001-2006) for the alternatives ranges from 1,274 to 1,402 thousand mt. In the Gulf of Alaska projected average pollock yield (2001-2006) for the alternatives ranges from 69 to 134 thousand mt. In both the EBS and GOA, alternative 2 is projected to provide the lowest average yield. In the EBS, the average yields for other alternatives are slightly higher, while in the GOA yields for the other alternatives are approximately twice as high as Alternative 2. Alternative 1 is projected to provide the highest average yields in the EBS, while in the GOA yields are slightly higher under Alternatives 4 and 5. As expected, the impact on spawning biomass shows an opposite trend, with the highest levels of spawning biomass occurring under Alternative 2. The spawning biomass was maintained above B_{msy} (2,125,000 mt) in the EBS, while in the GOA spawning biomass is below B_{msy} (218,000 mt) in 2001-2003 for each alternative, but rebuilds to above B_{msy} in 2004 and subsequent years. Projected average total biomass ranges from 9,894 to 10,175 thousand mt in the EBS, and ranges from 1,081 to 1,175 thousand mt in the GOA. The projected range of average age is less than half of a year in the EBS and close to half of a year in the GOA. These projections are presented in Table 4.2-1 for the eastern Bering Sea and in Table 4.2-2 for the GOA.

Table 4.2-1 Eastern Bering Sea walleye pollock. Five year population model projections of catch, ABC (Acceptable Biological Catch), spawning biomass, and total biomass under each alternative

	Year	EBS Pollock				
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Catch	2001	1,401	1,399	1,400	1,399	1,400
	2002	1,436	1,464	1,409	1,450	1,433
	2003	1,444	1,304	1,415	1,456	1,438
	2004	1,439	1,163	1,413	1,292	1,299
	2005	1,321	1,132	1,316	1,132	1,145
	2006	1,373	1,180	1,393	1,139	1,155
	Avg.	1,402	1,274	1,391	1,311	1,312
ABC	2001	1,878	1,399	1,878	1,878	1,878
	2002	1,965	1,464	1,965	1,965	1,965
	2003	1,766	1,304	1,708	1,731	1,739
	2004	1,496	1,163	1,458	1,396	1,412
	2005	1,321	1,132	1,316	1,241	1,250
	2006	1,373	1,180	1,393	1,322	1,325
	Avg.	1,633	1,274	1,620	1,589	1,595
Total biomass	2001	10,384	10,384	10,384	10,378	10,378
	2002	9,823	9,824	9,824	9,745	9,744
	2003	9,740	9,713	9,767	9,524	9,539
	2004	9,891	10,008	9,943	9,588	9,619
	2005	10,014	10,385	10,084	9,856	9,875
	2006	10,233	10,737	10,298	10,271	10,274
	Avg.	10,014	10,175	10,050	9,894	9,905
Spawning biomass	2001	3,140	3,141	3,141	3,141	3,141
	2002	2,681	2,677	2,685	2,679	2,681
	2003	2,370	2,380	2,386	2,349	2,359
	2004	2,313	2,405	2,340	2,276	2,288
	2005	2,347	2,530	2,378	2,339	2,345
	2006	2,420	2,658	2,445	2,477	2,476
	Avg.	2,545	2,632	2,563	2,544	2,548
Fishing mortality	2001	0.346	0.346	0.346	0.346	0.346
	2002	0.335	0.342	0.327	0.339	0.334
	2003	0.355	0.316	0.344	0.361	0.354
	2004	0.432	0.322	0.415	0.387	0.386
	2005	0.462	0.343	0.450	0.383	0.385
	2006	0.478	0.345	0.476	0.378	0.382
	Avg.	0.401	0.336	0.393	0.366	0.365
Equil. Avg. Age F=0		3.16	3.16	3.16	3.16	3.16
Equil. Avg. Age F40		2.28	2.28	2.28	2.28	2.28
Avg. Age Yr=2006		2.27	2.34	2.28	2.41	2.41

Note: Mean age for an unfished population, at $F_{40\%}$, and for 2006. Units of catch, ABC, spawning biomass and total biomass are thousands of metric tons.

Table 4.2-2 Gulf of Alaska walleye pollock. Five year population model projections of catch, ABC (Acceptable Biological Catch), spawning biomass, and total biomass under each alternative

		Pollock				
		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Catch (1000 t)	2001	100	45	81	100	100
	2002	80	44	53	80	80
	2003	105	59	92	105	105
	2004	138	77	140	149	149
	2005	155	89	155	179	179
	2006	168	100	166	190	190
	Avg.	124	69	114	134	134
ABC (1000 t)	2001	100	45	81	100	100
	2002	80	44	53	80	80
	2003	106	59	92	105	105
	2004	139	77	140	149	149
	2005	157	89	155	179	179
	2006	171	100	167	190	190
	Avg.	125	69	115	134	134
Spawning biomass	2001	203	208	205	203	203
	2002	166	188	175	166	166
	2003	181	211	196	182	182
	2004	220	265	238	223	223
	2005	241	304	256	245	245
	2006	253	332	265	251	251
	Avg.	210	251	222	211	211
Fishing mortality	2001	0.282	0.119	0.224	0.282	0.282
	2002	0.228	0.109	0.140	0.228	0.228
	2003	0.246	0.120	0.192	0.251	0.251
	2004	0.280	0.135	0.261	0.312	0.312
	2005	0.285	0.136	0.263	0.344	0.344
	2006	0.287	0.136	0.263	0.352	0.352
	Avg.	0.268	0.126	0.224	0.295	0.295
Total biomass (1000 t)	2001	886	886	886	889	889
	2002	926	975	942	948	948
	2003	1,041	1,115	1,080	1,069	1,069
	2004	1,158	1,264	1,204	1,183	1,183
	2005	1,224	1,371	1,260	1,235	1,235
	2006	1,253	1,437	1,282	1,247	1,247
	Avg.	1,081	1,175	1,109	1,095	1,095
EquilAvgAgeF0		3.599	3.599	3.599	3.599	3.599
EquilAvgAgeF40		2.650	2.650	2.650	2.650	2.650
Average Age Yr 2006		2.910	3.159	2.960	2.648	2.648

Note: Mean age for an unfished population, at $F_{40\%}$, and for 2006. Top rows of each block are equilibrium values at $F_{40\%}$. Units are thousands of metric tons.

4.2.2.1 Effects of Alternative 1 on Walleye Pollock

Under the current management regime - Alternative 1, which is described in the preceding section, the general impacts of fishing mortality within FMP Amendment 56/56 ABC/OFL definitions are discussed in Section 2.7.4 of the Draft Programmatic SEIS (NMFS 2001a), and apply to walleye pollock in the Aleutian Islands, the Bering Sea, and the Gulf of Alaska. Pollock in the Bering Sea fall within Tier 1a of the ABC/OFL definitions; in the Aleutian Islands they are in Tier 5; while in the GOA they are in Tier 3. For the Bering Sea, ABC's in 2001 were based on Tier 3 for Bering Sea pollock (which is lower than the maximum permissible value under F_{msy} calculations). We therefore base the projections for the EBS pollock using the Tier 3 management strategy. Because the pollock ABCs and TACs are lower than the maximum prescribed under the definitions (F_{msy} , $F_{40\%}$), the status quo impacts of fishing mortality provide lower risks of overfishing relative to the maximum prescribed in Amendment 56.

Projections of spawning biomass, total biomass, and expected catch were made through 2006 to examine the short-term impact of each alternative on the EBS and GOA walleye pollock stocks (Tables 4.2-1 and 4.2-2). Age structured models were not available for evaluation of impacts for the Aleutian Island so biomass projections were not produced. The projections start with the vector of 2001 numbers at age estimated in the most recent assessment (Ianelli et al. 2000, Dorn et al. 2000). Spawning biomass is computed in each year based on the time of peak spawning (March for the Gulf of Alaska and April for the Eastern Bering Sea stock) and the maturity and weight schedules described in the SAFE reports. Catch closely approximates the projected ABC for walleye pollock in all regions.

Total Biomass

In the EBS, average total biomass will decline to 9,740,000 mt in 2003 and will increase in subsequent years to 10,233,000 mt in 2006 (Tables 4.2-1). Under Alternative 1, the average of the total biomass projections for the years 2001-2006 is 10,014 t.

In the GOA, total biomass will increase from 886 thousand mt in 2001 to 1,253 thousand mt in 2006 (Table 4.2-2). Under Alternative 1, the average of the total biomass projections for the years 2001-2006 average is 1,081 t.

Spawning Biomass

The projections for the EBS pollock stock indicated that the expected spawning biomass would decrease 23% from 3,140 thousand mt in 2001 to 2,420 thousand mt in 2006 (Table 4.2-1).

The projections for the GOA pollock stock indicated that the expected spawning biomass would increase 20% from 203 thousand mt in 2001 to 256 thousand mt in 2006 (Table 4.2-2).

Catch Biomass

Catches of EBS pollock is expected to remain stable at approximately 1.4 million mt between 2001 and 2006 (Table 4.2-1). The average expected catch for the period 2001 - 2006 was 1,402,000 mt. These ranges in yields reflect pollock recruitment variability and the degree to which this variability affects short-term yields.

The average expected catch of GOA pollock for the period 2001 - 2006 was 124,000 mt.

Status Determination

The average expected fishing mortality rate for the EBS pollock stock was .40 which is below the overfishing level. The EBS pollock stocks are not overfished. In the EBS, spawning stock biomass is expected to be above BMSY (2,125,000 mt) in the year 2001 and will remain above BMSY in all projection years.

The average expected fishing mortality rate for GOA pollock is was 0.27. This fishing mortality rate is below the overfishing level. The GOA pollock stocks are not overfished under Amendment 56/56 ABC/OFL definitions. In the GOA, spawning stock biomass is expected to be below BMSY (218,000 mt) in the year 2001, but will increase above BMSY in 2004-2006.

Age and Size Composition

The current age and size compositions of BSAI and GOA walleye pollock are described in Section 3.2.1. The dominating factor determining the current age composition is the magnitude of the recruiting year classes. The selectivity of the fishery has cumulative impacts on the age composition due to fishing mortality, and the current size and age structure is also the result of a greater than 35-year history of exploitation. Changes in the size composition are a direct effect of the changes in the age composition due to exploitation, and, potentially, an indirect effect due to density-dependent growth. While density-dependent effects on growth are likely to exist, at this time no reliable estimates of these effects are available.

Under Alternative 1, the average age of the EBS pollock stock in 2006 is expected to be 2.27y. This value can be compared to an expected average age in an unfished population of 3.16y.

The average age of the GOA pollock stock in 2006 is estimated to be 2.91y. The average expected age of an unfished population is 3.6y.

Sex Ratio

A 50:50 sex ratio is assumed for both the BSAI and GOA pollock assessment and projections. Current estimates of the population sex ratio indicate values close to 50:50, and investigations on the impact of possible targeting (e.g., during the pollock roe fishery) have indicated that this value does not change appreciably. However, future changes may occur due to technological developments or changes in fish distribution. Unfortunately, predicting these changes is not possible because no pattern has been detected from currently available information.

Spatial / Temporal Concentration of Fishing Mortality

The directed fishery for pollock is prosecuted by mid-water trawlers. A detailed description of the current directed fishery is in Section 2.5.1. Historically, large fractions of the total removals occurred in a relatively short period of time in a fairly concentrated area. In the EBS, the passage of the AFA served to reduce the race for fish and disperse the fishing effort over broader areas. Under Alternative 1, certain management measures designed to disperse the catch spatially and temporally would be removed. At the extreme, one might predict that fisheries would return to highly aggregated events in time and space. However, the opportunity for more controlled fishing under AFA would likely mitigate that tendency. Thus, it is likely that some additional temporal and spatial aggregation of fishing would occur within critical habitat.

Habitat - Mediated Impacts

The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 1 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST. However, it should be recognized that genetic structure of pollock is not well understood. This alternative could result in depletion of relatively distinct spawning populations not presently recognized under the current management system, particularly those close to major ports.

Predation - Mediated Impacts

The trophic interactions of pollock are described in Section 3.2.1. The current levels and distribution of harvest do not appear to impact prey availability such that it affects the sustainability of the stock as measured by the ability of the stock to maintain itself above its MSST.

4.2.2.2 Effects of Alternative 2 on Walleye Pollock

The slow and low approach calls for several management changes. Of these the most notable changes include:

- Closed areas for BSAI and GOA fisheries;
- Seasonal redistribution of pollock TAC.
- TAC proportional to the biomass in the region ;

Alternative 2 seeks to redistribute pollock catch outside critical habitat in the EBS and GOA. The AI region would be closed to all pollock fishing. To mitigate against disproportional harvest rates in areas remaining open, Alternative 2 adjusts TAC in open regions to the proportion of biomass thought to be in the area in 1999. Alternative 2 reduces the total allowable catch in the EBS to 74.5 % of the maximum permissible ABC, while the total allowable catch in the GOA would be reduced to 44.8 % of the maximum permissible ABC.

Predicting the likelihood that harvest rates are in fact proportional to biomass in any single year is difficult because pollock distributions are not static. Bottom trawl and acoustic surveys demonstrate that pollock distributions vary considerably interannually. The distribution of pollock biomass within the EBS and GOA is dependent on the composition of the stock and environmental conditions. In the EBS, younger pollock tend to be concentrated in the Northwestern shelf while mature pollock are more common in the southeastern Bering Sea shelf, especially during spawning (Lynde et al. 1986, Shuck 2000). If estimates of underlying pollock distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates within a region. In the EBS, the large shelf area coupled with cooperative fishing ventures would reduce the "race for fish" for the seasonal TAC allocations.

Spawning Biomass

In the absence of compensatory processes, reductions in catch will lead to increased spawning potential (Table 4.2-1). Under Alternative 2, the expected spawning biomass in the EBS decreases 18% from 3,141,000 mt in 2001 to 2,380,000 mt in 2003. After 2003, average spawning biomass is expected to increase to 2,658,000 mt in 2006. The short term decrease in spawning biomass results from starting the model when the EBS pollock spawning biomass is above average.

In the GOA, the expected spawning biomass decreases 10% from 208,100 mt in 2001 to 188,100 mt in 2002 (Table 4.2-2). After 2002, spawning biomass is expected to increase to 332,000 mt in 2006.

Catch Biomass

Relative to Alternative 1, the pollock fisheries would be expected to have less catch in the A, B, and D seasons, and no catch would be allowed from November 1 through December 31. In the EBS, fishing effort is likely to be reduced over time to adjust for reductions in temporal partitions of catch because of cooperative fishing agreements. However in the short-term, the temporal/seasonal TACs are expected to be taken more quickly than in Alternative 1 because of overcapacity of the fleet. Relative to Alternative 1, the pollock fishing effort would be much lower in the AI since Alternative 2 imposes a ban on commercial pollock trawling in this region.

As prescribed by the Alternative, pollock catches would be significantly reduced under Alternative 2. In the EBS, the expected pollock catch in 2006 is 1,180,000 mt (Table 4.2-1). In the GOA, the expected pollock catch in 2006 is 99,700 mt (Table 4.2-2).

Status Determination

In the EBS, the projected average fishing mortality rate for the period 2001 - 2006 was 0.34, which is below the overfishing level (Table 4.2-1). The EBS and AI pollock stocks are not overfished and spawning biomass levels are maintained above BMSY.

In the GOA, the projected average fishing mortality rate for the period 2001 - 2006 was 0.13, which is below overfishing level (Table 4.2-2). The GOA pollock stocks are not overfished and spawning biomass levels are maintained above BMSY.

Age and Size Composition

Alternative 2 could have an impact on the size and age compositions of the EBS, AI, and GOA pollock populations as catches are significantly reduced relative to status quo. There will be reduced fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of lower fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of lower fishing mortality rates could cause a shift in the age and size compositions. Closure of pollock spawning areas near the Alaska Peninsula in the EBS and in Shelikof Strait may shift fishing selectivity towards younger fish. Projection models for EBS pollock with changing selectivity suggest that this effect has minor impact on pollock population dynamics. Since annual stock assessments would pick up these changes in selectivity, the same percentage of spawning biomass per recruit would be protected even with changing fishing selectivity patterns.

Under Alternative 2, the average age of the EBS pollock stock in 2006 is expected to be 2.34y. This value can be compared to an expected average age in an unfished population of 3.16y.

The average age of the GOA pollock stock in 2006 is estimated to be 3.16y. The average expected age of an unfished population is 3.6y.

Sex Ratio

A 50:50 sex ratio is assumed for the pollock assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 2.

Spatial / Temporal Concentration of Fishing mortality

If the spatial / temporal partitions correctly map the underlying distribution of pollock within the EBS, GOA and AI, and the fishing fleet voluntarily re-distributed their effort to adjust for reduced TAC then Alternative 2 may serve to provide increased protection to pollock. The spatial / temporal partitions would minimize the possibility of overharvesting a portion of the stock.

If the spatial /temporal partitions correctly mapped the underlying distribution of pollock during the spawning season, this alternative would increase the likelihood of preserving genetic diversity. The spawning populations outside of critical habitat would be harvested at a sustainable rate, and spawning populations within critical habitat would be excluded from commercial fishing harvest during the spawning season.

Habitat- Mediated Impacts

Under Alternative 2 temporal and spatial aggregation of fishing would be reduced. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 2 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation - Mediated Impacts

Ianelli et al. (1999) provide evidence of dome-shaped spawner recruitment relationship for EBS pollock. This relationship suggests that reduced productivity of the stock may occur at high spawning biomass levels. Adult pollock are cannibalistic (Dwyer et.al. 1987), and an in adult pollock abundance may lead to increased juvenile pollock mortality. This relationship was not incorporated into the projections shown in Table 4.2-1.

Lower catches of Atka mackerel, pollock and Pacific cod would impact the amounts of pollock available to the ecosystem. Under Alternative 2, more commercial sized pollock would be available as prey and predators in the ecosystem. Pollock are an important component in the diet of numerous groundfish, sea birds and marine mammals. Lower catches of Pacific cod could increase their predation on pollock. General information on the trophic interactions of pollock in the AI, EBS and GOA are described in Section 3.2.1. Overall, the impacts of Alternative 2 are large increases in these trophic interactions. However, shifts in these interactions are difficult to predict because of the complex nature of the food web. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.2.3 Effects of Alternative 3 on Walleye Pollock

The restricted and closed area approach calls for several management changes. The most notable include:

- A global control rule, whereby the recommended fishing mortality rate for pollock in the BSAI and GOA would be reduced more rapidly than the default rate under Amendment 56 when the spawning biomass is estimated to be less than 40% of the projected unfished biomass;
- A seasonal redistribution of pollock TAC;
- A mosaic of open and closed areas for BSAI and GOA fisheries;

Spawning Biomass

Under Alternative 3, the expected average spawning biomass in the EBS decreases 22% from 3,141,000 mt in 2001 to 2,445,000 mt in 2006 because pollock are currently above BMSY. As a result, the harvest control rule for alternative 3 does not affect the ABC harvest rate.

In the GOA, expected average spawning biomass increases 30% from 204,000 mt in 2001 to 265,3000 mt in 2006 because GOA pollock are currently below BMSY. The projected stock size in 2006 is higher than Alternative 1.

Catch

The global control rule would reduce the harvest of pollock in CH beyond the level prescribed by Amendment 56 when spawning stocks were low. These actions are likely to ensure that EBS, GOA and AI pollock stocks are harvested at a sustainable rate. Under Alternative 3, the overall pollock catch in the EBS would not be significantly reduced, the alternative only impacts the amount of harvest within critical habitat.

In the EBS, pollock catch will be nearly unchanged under Alternative 3 when compared to Alternative 1. In the EBS, the expected pollock catch in 2006 is 1,393,000 mt (Table 4.2-1).

In the GOA, where a high percent of the stock occurs within critical habitat throughout the year, it is likely that the percent of the TAC available for harvest outside critical habitat will not be completely taken by the fleet. The harvest control rule for Alternative 3 significantly reduces the harvest rate in the first few years of the projection, resulting in higher stock size and catch in 2006 relative to alternative 1. In the GOA, the expected pollock catch in 2006 is 166,300 mt. Mean catches and the variability of catches are higher under this alternative.

Status Determination

For EBS pollock the projected average fishing mortality rate for the period 2001 - 2005 was 0.39 which is below the overfishing level. The EBS and AI pollock stocks are not overfished and spawning biomass levels are maintained above BMSY under this alternative.

For GOA pollock the projected average fishing mortality rate for the period 2001 - 2006 was 0.22 which is below the overfishing level. The GOA pollock stock is not expected to become overfished under this Alternative.

Age and Size Composition

Alternative 3 are not likely to have an impact on the size and age compositions of the EBS and AI pollock populations as catches while reduced are spatially distributed across region in a manner similar to Alternative 1. There will be reduced fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of lower fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of lower fishing mortality rates could cause a shift in the age and size compositions.

Under Alternative 3, the average age of the EBS pollock stock in 2006 is expected to be 2.28y. This value can be compared to an expected average age in an unfished population of 3.16y (Table 4.2-1).

The average age of the GOA pollock stock in 2006 is estimated to be 2.96y. The average expected age of an unfished population is 3.6y (Table 4.2-2).

Sex Ratio

A 50:50 sex ratio is assumed for the pollock assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 3.

Spatial / Temporal Concentration of Fishing mortality

Alternative 3 seeks to reduce localized depletion by redistributing pollock catch within the EBS, AI and GOA. Determining whether harvest rates are in fact proportional to biomass in any single year is difficult because pollock distributions are not static. Bottom trawl and acoustic surveys demonstrate that pollock distributions vary considerably interannually. The distribution of pollock biomass within both the EBS and GOA is dependent on the composition of the stock and environmental conditions.

In the EBS, younger pollock tend to be concentrated in the Northwestern shelf while mature pollock are more common in the southeastern Bering Sea shelf, especially during spawning (Lynde et al. 1986, Shuck 2000). If estimates of underlying pollock distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates within a region. In the EBS, the large shelf area coupled with cooperative fishing ventures would reduce the "race for fish" for the seasonal TAC allocations.

Because management areas in the GOA under this alternative are relatively small, i.e., a fraction of critical habitat within an INPFC area, the potential for inadvertently overharvesting local pollock aggregations is greater under this alternative.

The spatial partitions coupled with the global control rule would increase the likelihood of preserving genetic diversity. The closed areas would ensure that some portions of the stock were completely protected from directed fishing.

Under Alternative 3 temporal and spatial aggregation of fishing would be reduced but it is not expected to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Habitat-Mediated Impacts

The level of habitat disturbance expected under Alternative 3 is not expected to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation - Mediated Impacts

Lower catches of pollock in critical habitat would impact the amounts of pollock available to the ecosystem. Under Alternative 3, more commercial sized pollock would be available as prey and predators in critical habitat. Pollock are an important component in the diet of numerous groundfish, sea birds and marine mammals. General information on the trophic interactions of pollock in the AI, EBS and GOA are described in Section 3.2.1. Overall, Alternative 3 would impact trophic interactions in coastal regions of the BSAI. However, shifts in these interactions are difficult to predict because of the complex nature of the food web. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.2.4 Effects of Alternative 4 on Walleye Pollock

The area and fishery specific approach calls for several management changes. The most notable include:

- A modified global control rule, whereby the directed fishery for pollock in the BSAI would be reduced to zero when the spawning biomass is estimated to be less than 20% of the projected unfished biomass;
- A seasonal redistribution of EBS pollock TAC: January 20 - June 10 (40%) and June 10 - November 1 (60%); GOA pollock: four seasonal apportionments January 20 - Feb 25 (25%), March 15 - May 31 (25%), September 1 - September 15 (25%), October 1 - November 1 (25%);
- Closed areas for BSAI and GOA fisheries, including 10 nm no trawl zones north of the Alaskan Peninsula and the Aleutian chain, and a portion of critical habitat in the GOA;
- Prohibition of trawl catcher-processors in the CVOA between June 10 and December 31;
- Closure of the Aleutian Islands to pollock fishing in 2002;
- A harvest limit in the SCA during the A-season established at 28% of the annual TAC.

Spawning Biomass

In both the EBS and the GOA, the expected average spawning biomass for Alternative 4 is nearly equivalent to Alternative 1. Under Alternative 4, the expected average spawning biomass in the EBS decreases 21% from 3,141,000 mt in 2001 to 2,477,000 mt in 2006.

The expected average spawning biomass in the GOA increased 24% from 202,700 mt in 2001 to 250,700 mt in 2006. This increase occurs because pollock in the GOA is currently below BMSY and model projections assume no relationship between spawning stock and recruitment.

Catch

The global control rule would reduce the harvest of pollock beyond the level prescribed by Amendment 56 when spawning stocks were extremely low. However, it is unlikely that pollock stocks will reach these levels unless a strong tendency for prolonged periods of weak year classes develops in this population. These actions are likely to ensure that BSAI and GOA pollock stocks are harvested at a sustainable rate.

Relative to Alternative 1, pollock catch in the EBS decreases very slightly under Alternative 4 (Table 4.2-1). In the EBS, the expected pollock catch in 2006 is 1,139,000 mt.

Relative to Alternative 1, pollock catch in the GOA increases under Alternative 4 (Table 4.2-1). The expected catch in 2006 is 189,800 mt (Table 4.2-2).

Status Determination

For EBS pollock, the projected average fishing mortality rate for the period 2001 - 2006 was 0.37, which is below F_{0.1}. Pollock catch in the GOA increases very slightly under Alternative 4 (Table 4.2-1). Spawning biomass remains safely above BMSY in all years and fishing mortality would be reduced in the event that low spawning biomass occurs. The pollock stock in the EBS is not overfished.

For GOA pollock, the projected average fishing mortality rate for the period 2001 - 2006 was 0.29, which is below the overfishing level. Fishing mortality would be reduced under this alternative in the event that low spawning biomass occurs. The pollock stock in the GOA is not overfished.

Age and Size Composition

Alternative 4 is not likely to have an impact on the size and age compositions of the EBS and GOA pollock populations as catches are not significantly different from Alternative 1. There will be reduced fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of lower fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of lower fishing mortality rates could cause a shift in the age and size compositions.

Sex Ratio

A 50:50 sex ratio is assumed for the pollock assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 4.

Spatial / Temporal Concentration of Fishing mortality

Alternative 4 seeks to reduce localized depletion by redistributing pollock catch within the AI and EBS. Predicting the likelihood that this goal is achieved in any single year is difficult because pollock distributions are not static. Bottom trawl and acoustic surveys demonstrate that pollock distributions vary considerably interannually. The distribution of pollock biomass within the EBS and GOA is dependent on the composition of the stock and environmental conditions. In the EBS, younger pollock tend to be concentrated in the Northwestern shelf while mature pollock are more common in the southeastern Bering Sea shelf, especially during spawning (Lynde et al. 1986, Shuck 2000). If estimates of underlying pollock distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates

within a region. In the EBS, the large shelf area coupled with cooperative fishing ventures would reduce the "race for fish" for the seasonal TAC allocations.

Relative to Alternative 1, the overall pollock catch in the EBS would be taken earlier in the year because of the June 10 start date for the B season. In the GOA, the seasonal distribution of catch would be similar to Alternative 1.

The spatial partitions would increase the likelihood of preserving genetic diversity. In the AI, no fishing would be allowed in critical habitat. In the EBS, the 10 nm closed areas would ensure that some portions of the stock was protected from directed fishing.

Habitat-Mediated Impacts

The level of habitat disturbance under Alternative 4 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation - Mediated Impacts

Lower catches of pollock in critical habitat would increase the amounts of pollock available to the ecosystem in coastal regions. Under Alternative 4, more commercial sized pollock would be available as prey and predators in critical habitat. Pollock are an important component in the diet of numerous groundfish, sea birds and marine mammals. General information on the trophic interactions of pollock in the AI, EBS and GOA are described in Section 3.2.1. Overall, Alternative 4 would impact trophic interactions in coastal regions of the BSAI and the GOA. However, shifts in these interactions are difficult to predict because of the complex nature of the food web. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.2.5 Effects of Alternative 5 on Walleye Pollock

The critical habitat catch limit approach calls for several management changes. This alternative seeks to limit the amount of catch of EBS pollock within critical habitat to be in proportion to estimated fish biomass.

- A seasonal redistribution of EBS pollock TAC: with four seasons inside critical habitat and 2 seasons outside critical habitat.
- GOA pollock fishery distributed over 4 seasons (30%, 15%, 30%, 25%).
- Closed areas for BSAI and GOA fisheries, within 10 or 20 nm of 75 haulouts seasonally or year - round on use by sea lions (Figure 2.3.?);
- No directed fishing for pollock in the Aleutian Islands.

Spawning Biomass

Under Alternative 5, the expected average spawning biomass in the EBS would decrease 21% from 3,141,000 mt in 2001 to 2,476,000 mt in 2006 (Table 4.2-1).

Expected average spawning biomass in the GOA would increase 24% from 202,700 mt in 2001 to 250,700 mt in 2006 (Table 4.2-1). This increase occurs because pollock in the GOA is currently below BMSY and model projections assume no relationship between spawning stock and recruitment.

Alternative 5 is not likely to have a significant impact on the size and age compositions of the EBS and GOA pollock populations. In the short-term, the impacts of lower fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions.

Catch

Relative to Alternative 1, pollock catch in the EBS decreases slightly under Alternative 5 (Table 4.2-1). In the EBS, the expected pollock catch in 2006 is 1,155,000 mt.

Pollock catch in the GOA increases slightly under Alternative 5 (Table 4.2-2). In the GOA, the expected pollock catch in 2006 is 189,800 mt.

Status Determination

For EBS pollock the projected average fishing mortality rate for the period 2001 - 2006 was 0.36, which is below F_{OFL} . The EBS and AI pollock stocks are not overfished and spawning biomass remains safely above BMSY in all years.

For GOA pollock the projected average fishing mortality rate for the period 2001 - 2006 was 0.29, which is below F_{OFL} . The pollock stock in the GOA is not overfished.

Sex Ratio

A 50:50 sex ratio is assumed for the pollock assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 5.

Spatial / Temporal Concentration of Fishing Mortality

Relative to Alternative 1, the pollock fisheries within CH in the EBS would be expected to have less catch in the A, B, and D seasons, and no catch would be allowed from November 1 through December 31. In the EBS, fishing effort is likely to be reduced over time to adjust for reductions in temporal partitions of catch because of cooperative fishing agreements. However in the short-term, the temporal/seasonal TACs are expected to be taken more quickly than in Alternative 1 because of overcapacity of the fleet. Relative to Alternative 1, the pollock fishing effort would be much lower in the AI since Alternative 5 imposes a ban on commercial pollock trawling in this region. In the GOA, this alternative would establish a fourth season, and shift more of the catch to the winter (A and B seasons, 45%) versus 25% under Alternative 1.

Under Alternative 5 temporal and spatial aggregation of fishing would be reduced. The spatial partitions around haulouts and rookeries would increase the likelihood of preserving genetic diversity. In the AI no directed pollock fishing would be allowed.

Habitat -Mediated Impacts

The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 5 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation-Mediated Impacts

Lower catches of pollock in critical habitat would impact the amounts of young and old pollock available to the ecosystem. Under Alternative 5, more commercial sized pollock would be available as prey and predators in critical habitat. Pollock are an important component in the diet of numerous groundfish, sea birds and marine mammals. General information on the trophic interactions of pollock in the BSAI and GOA are described in Section 3.2.1. Alternative 5 would impact these trophic interactions in coastal regions of the BSAI. Shifts in these interactions are difficult to predict because of the complex nature of the food web. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.2.6 Summary of Effects on Walleye Pollock

The criteria used to estimate the significance of direct and indirect impacts of Alternatives 1 through 5 on the BSAI and GOA stocks of pollock outlined in Table 4.2-3. These criteria are applicable to the other assessed targeted groundfish stocks discussed in this section as well. The rating of conditionally significant (either positive or negative) is not applicable in this analysis as the model projections yielded results that were deemed either significant (positive or negative), insignificant, or unknown. Tables 4.2-4 and 4.2-5 summarize the effects of Alternatives 1 through 5 on pollock stocks in the EBS and GOA.

The ratings utilize an the MSST as a basis for positive or negative impacts of each alternative (Table 4.2-3). A thorough description of the rationale for the MSST can be found in the National Standard Guidelines 50 CFR Part 600 (Federal Register Vol. 63, No. 84, 24212 - 24237). Under Alternatives 1 - 5, the spawning stock biomass of GOA, and EBS pollock is expected to be above the MSST. The probability that overfishing would occur is low for all of the pollock stocks (AI, GOA, EBS, Bogoslof and SE). The EBS and GOA pollock stocks are currently above their MSSTs and the expected changes under each alternative are not substantial enough to expect that the genetic diversity or reproductive success of these stocks would change under the new management regime. None of the Alternatives would allow overfishing of the spawning stock therefore the genetic integrity and reproductive potential of the stocks should be preserved.

Table 4.2-3 Criteria used to estimate the significance of effects on targeted groundfish stocks in the Bering Sea, Aleutian Islands, and Gulf of Alaska by Alternatives 1 through 5

Intensity of the Effects						
Direct Effects	Significant Adverse	Conditionally Significant Negative	Unknown	Insignificant Impact	Conditionally Significant Positive	Significant Positive
Fishing mortality	Reasonably expected to jeopardize the capacity of the stock to produce MSY on a continuing basis: mean F2001-2006>FOFL	NA	Unknown fishing mortality rate	Reasonably <i>not</i> expected to jeopardize the capacity of the stock to produce MSY on a continuing basis: mean F2001-2006<=FOFL	NA	NA
Spatial temporal distribution of catch						
Leads to change in genetic structure of population	Evidence of genetic sub-population structure and evidence that the distribution of harvest leads to a detectable reduction in genetic diversity such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	MSST and genetic structure is unknown, therefore no information to evaluate whether distribution of the catch changes the genetic structure of the population such that it jeopardizes or enhances the ability of the stock to sustain itself at or above the MSST	Evidence that the distribution of harvest is <i>not</i> sufficient to alter the genetic sub-population structure such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	Evidence of genetic sub-population structure and evidence that the distribution of harvest leads to a detectable increase in genetic diversity such that it enhances the ability of the stock to sustain itself at or above the MSST

Direct Effects	Significant Adverse	Conditionally Significant Negative	Unknown	Insignificant Impact	Conditionally Significant Positive	Significant Positive
Change in reproductive success	Evidence that the distribution of harvest leads to a detectable decrease in reproductive success such that it jeopardizes the ability of the stock to sustain itself at or above MSST	NA	MSST is unknown therefore no information regarding the potential impact of the distribution of the catch on reproductive success such that it jeopardizes or enhances the ability of the stock to sustain itself at or above the MSST	Evidence that the distribution of harvest will <i>not</i> change reproductive success such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA.	Evidence that the distribution of harvest leads to a detectable increase in reproductive success such that it enhances the ability of the stock to sustain itself at or above MSST

Intensity of the Effects						
Indirect Effects	Significant Adverse	Conditionally Significant Negative	Unknown	Insignificant Impact	Conditionally Significant Positive	Significant Positive
Change in prey availability	Evidence that current harvest levels and distribution of harvest lead to a change prey availability such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	MSST is unknown therefore no information that current harvest levels and distribution of harvest lead to a change in prey availability such that it enhances or jeopardizes the ability of the stock to sustain itself at or above the MSST	Evidence that current harvest levels and distribution of harvest do <i>not</i> lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	Evidence that current harvest levels and distribution of harvest lead to a change prey availability such that it enhances the ability of the stock to sustain itself at or above the MSST
Habitat: Change in suitability of spawning, nursery, or settlement habitat, etc. due to fishing	Evidence that current levels of habitat disturbance are sufficient to lead to a decrease in spawning or rearing success such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	MSST is unknown therefore no information that current levels of habitat disturbance are sufficient to lead to a detectable change in spawning or rearing success such that it enhances or jeopardizes the ability of the stock to sustain itself at or above the MSST	Evidence that current levels of habitat disturbance are not sufficient to lead to a detectable change in spawning or rearing success such that it jeopardizes the ability of the stock to sustain itself at or above the MSST	NA	Evidence that current levels of habitat disturbance are sufficient to lead to an increase in spawning or rearing success such that it enhances the ability of the stock to sustain itself at or above

Note: NA = Not applicable.

Table 4.2-4 Summary of effects of Alternatives 1 through 5 on pollock in the eastern Bering Sea.

Species/Species Groups	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Eastern Bering Sea Walleye Pollock					
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.2-5 Summary of effects of Alternatives 1 through 5 on pollock in the Gulf of Alaska.

Gulf of Alaska Walleye Pollock	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative.

4.2.3 Effects of the Alternatives on Pacific cod

This section describes the likely impacts of the various alternatives on Pacific cod (see Section 3 for background information on this species). For the most part, this description focuses on the results of quantitative analysis undertaken through the stock projection model described in Section 4.2.1.

To provide an advance summary of some of the highlights from this description, the Table 4.2-6 lists the alternative(s) that produced the lowest and highest values for each of eight key variable/area combinations,

along with the ratio between the lowest and highest value for each variable/area combination (biomass and catch are in mt, age is in years):

Table 4.2-6 Alternatives yielding lowest and highest values and ratio for variables in the Bering Sea and Aleutians Islands, and the Gulf of Alaska

Variable	Area	Lowest		Highest		Low/High
		Alternative	Value	Alternative	Value	
Average total biomass	BSAI	4&5	1,585,000	2	1,788,00	0.89
Average total biomass	GOA	1	628,900	2	670,300	0.94
Average spawning biomass	BSAI	4&5	330,000	2	404,000	0.82
Average spawning biomass	GOA	1	82,400	2	97,100	0.85
Average catch	BSAI	2	101,000	1	185,000	0.55
Average catch	GOA	2	42,500	4&5	61,800	0.69
Average age	BSAI	1	2.61	2	2.77	0.94
Average age	GOA	4&5	2.72	2	2.82	0.96

For both the BSAI and GOA Pacific cod stocks, impacts of Alternatives 1, 4 and 5 were very similar (Tables 4.2-2 and 4.2-3) with respect to catch and biomass projections. Alternative 2 produced the lowest average catch in both areas and the highest average total biomass, average spawning biomass, and average age in both areas.

The range of values encompassed by the outputs was rather modest in some cases, at least when measured in percentage terms. For example, the lowest average age was only 6% less than the highest in the case of the BSAI and only 4% less than the highest in the case of the GOA. On the other hand, the lowest average catch was 45% less than the highest in the case of the BSAI and 31% less than the highest in the case of the GOA. Average total biomass and average spawning biomass were associated with ranges of values intermediate between these two extremes. The lowest average total biomass was 11% less than the highest in the case of the BSAI and 6% less than the highest in the case of the GOA. The lowest average spawning biomass was 18% less than the highest in the case of the BSAI and 15% less than the highest in the case of the GOA.

As noted above, quantitative analysis of likely impacts under the various alternatives was undertaken primarily through the stock projection model described in Section 4.2.1. For each alternative, results from different runs of the stock projection model are presented in Tables 4.2-2 through 4.2-3. For each alternative and each of the two management areas (BSAI and GOA), the stock projection model was run using parameter values appropriate to that alternative/area combination for the purpose of generating a set of projected values.

Table 4.2-7 Eastern Bering Sea Pacific cod. Five year population model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under each alternative.

		Alt1	Alt2	Alt3	Alt4	Alt5
Equil. Catch @ F40%		265	265	265	265	265
Catch	2001	219	93	192	219	219
	2002	169	91	159	169	169
	2003	144	89	124	143	143
	2004	156	98	140	154	154
	2005	192	111	190	178	178
	2006	229	121	189	195	195
	Avg.	185	101	166	176	176
ABC	2001	219	158	213	219	219
	2002	169	153	159	169	169
	2003	144	150	124	143	143
	2004	156	168	140	155	155
	2005	192	196	191	188	188
	2006	229	217	240	219	219
	Avg.	185	174	178	182	182
Spawning Biomass	2001	374	383	376	374	374
	2002	333	385	344	333	333
	2003	302	378	317	302	302
	2004	300	388	320	299	299
	2005	324	421	346	320	320
	2006	353	468	376	351	351
	Avg.	331	404	347	330	330
Fishing Mortality	2001	0.279	0.111	0.240	0.279	0.279
	2002	0.247	0.113	0.223	0.247	0.247
	2003	0.222	0.112	0.183	0.222	0.222
	2004	0.221	0.112	0.188	0.219	0.219
	2005	0.239	0.112	0.226	0.224	0.225
	2006	0.263	0.109	0.206	0.227	0.228
	Avg.	0.241	0.112	0.206	0.227	0.227
Total Biomass	2001	1,508	1508	1508	1508	1,508
	2002	1,413	1546	1442	1409	1,409
	2003	1469	1665	1505	1453	1,453
	2004	1613	1836	1664	1582	1,582
	2005	1760	2009	1821	1721	1,721
	2006	1866	2162	1920	1838	1,838
	Avg.	1,605	1,788	1,643	1,585	1,585
Equil. Age F=0		3.20	3.20	3.20	3.20	3.20
Avg. Age 2006		2.61	2.77	2.65	2.67	2.67

Note: The B_{MSY} proxy is 340,000 t of spawning biomass, and the F_{MSY} proxy ($F_{35\%}$) is 0.35. Catch, ABC, and biomass estimates are in thousands of mt.

Table 4.2-8 Gulf of Alaska Pacific cod. Five year population model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under each alternative

Equil. Catch @ F40%		Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
		265		265		265		265		265	
Catch	2001	81.4		44.8		81.4		81.4		81.4	
	2002	64.7		42.1		61.2		64.7		64.7	
	2003	50.6		39.3		43.7		50.6		50.6	
	2004	49.2		39.1		43.7		49.3		49.3	
	2005	57.0		42.8		54.1		57.2		57.2	
	2006	66.8		46.9		64.7		67.7		67.7	
	Average	61.6		42.5		58.1		61.8		61.8	
ABC	2001	81.4		44.8		81.4		81.4		81.4	
	2002	64.7		42.1		61.2		64.7		64.7	
	2003	50.6		39.3		43.7		50.6		50.6	
	2004	49.2		39.1		44.1		49.3		49.3	
	2005	57.1		42.8		55.9		57.2		57.2	
	2006	67.0		47.1		68.8		67.7		67.7	
	Average	61.7		42.5		59.2		61.8		61.8	
Spawning Biomass	2001	100.2		102.4		100.2		100.2		100.2	
	2002	85.4		97.8		85.6		85.4		85.4	
	2003	75.6		93.0		77.1		75.6		75.6	
	2004	73.4		91.7		76.6		73.4		73.4	
	2005	77.1		95.5		81.3		77.3		77.3	
	2006	82.8		102.4		87.2		83.2		83.2	
	Average	82.4		97.1		84.7		82.5		82.5	
Fishing Mortality	2001	0.374		0.194		0.374		0.374		0.374	
	2002	0.349		0.194		0.328		0.349		0.349	
	2003	0.307		0.194		0.258		0.307		0.307	
	2004	0.297		0.191		0.252		0.297		0.297	
	2005	0.312		0.194		0.282		0.314		0.314	
	2006	0.335		0.194		0.310		0.339		0.339	
	Average	0.314		0.194		0.282		0.314		0.314	
Total Biomass	2001	601.4		601.4		601.4		601.6		601.6	
	2002	574.4		610.0		574.4		575.4		575.4	
	2003	589.2		640.3		592.6		591.6		591.6	
	2004	629.7		682.2		639.3		633.3		633.3	
	2005	673.1		725.6		686.5		677.1		677.1	
	2006	705.3		762.0		719.3		709.1		709.1	
	Average	628.9		670.3		635.6		631.4		631.4	
Equil. Age F=0 Avg. Age 2006		3.195		3.195		3.195		3.195		3.195	
		2.731		2.822		2.750		2.718		2.718	

Note: The B_{MSY} proxy for this stock is 79,900t of spawning biomass and the F_{MSY} proxy ($F_{35\%}$) is 0.46. Catch, ABC, and biomass estimates are in thousands of mt.

4.2.3.1 Effects of Alternative 1 on Pacific cod

Total Biomass

Total (ages 1 through 12+) biomass of BSAI Pacific cod at the start of 2001 is estimated to be 1,508,000 mt. Model projections of future total BSAI biomasses are shown in Table 4.2-7. Under Alternative 1, model projections indicate that total BSAI biomass is expected to decline to a value of 1,413,000 mt by 2002, then increase to a value of 1,866,000 mt by 2006, with a 2001-2006 average value of 1,605,000 mt.

Total biomass of GOA Pacific cod at the start of 2001 is estimated to be 601,400 mt. Model projections of future total GOA biomasses are shown in Table 4.2-8. Under Alternative 1, model projections indicate that total GOA biomass is expected to decline to a value of 574,000 mt by 2002, then increase to a value of 705,300 mt by 2006, with a 2001-2006 average value of 628,800 mt.

Spawning Biomass

Spawning biomass of female BSAI Pacific cod at the start of 2001 is estimated to be 374,000 mt. Model projections of future BSAI spawning biomasses are shown in Table 4.2-7. Under Alternative 1, model projections indicate that BSAI spawning biomass is expected to decline to a value of 300,000 mt by 2004, then increase to a value of 353,000 mt by 2006, with a 2001-2006 average value of 331,000 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 340,000 mt for the years 2002-2005, but exceeds the B_{MSY} proxy value in 2006.

Spawning biomass of female GOA Pacific cod at the start of 2000 is estimated to be 100,200 t. Model projections of future GOA spawning biomasses are shown in Table 4.2-8. Under Alternative 1, model projections indicate that GOA spawning biomass is expected to decline to a value of 73,400 t by 2004, and increasing to 82,800 t by 2006, with a 2001-2006 average value of 82,400 t. Projected spawning biomass dips below the B_{MSY} proxy value of 79,900 t for the years 2003-2005, but exceeds the B_{MSY} proxy value in 2006.

Fishing Mortality

The average fishing mortality imposed on the BSAI Pacific cod stock in 2001 is 0.279. Model projections show this value will decrease to 0.221 in 2004 and increase to 0.263 in 2006. These values are well below the F_{MSY} proxy value of 0.35 which is the rate associated with the overfishing level.

The average fishing mortality imposed on the GOA Pacific cod stock in 2001 is projected to be 0.374 under Alternative 1. Fishing mortality is projected to decrease to 0.297 in 2004 and increase subsequently to 0.335 in 2006. These values are well below the F_{MSY} proxy value of 0.46 which is the rate associated with the overfishing level.

Spatial / Temporal Concentration of Fishing Mortality

Under Alternative 1, all Steller sea lion protection measures passed by emergency rule after 1998 would be rescinded. Under this alternative, it is likely that fishing activity would continue to be concentrated in near shore regions north of Unimak Pass (cod alley), and the eastside of Kodiak Island (see Figures E3-15-E3-34). Likewise, trawl fishing would continue to be concentrated in the winter months.

Pacific cod undergo large migrations and some degree of genetic mixing is expected for this stock. The degree of spatial and temporal concentration of the fishery is not likely to result in depletion of sub-populations of Pacific cod if they exist. A temporal concentration of fishing during the winter months would coincide with periods of peak spawning. However, historical concentrations of fishing during the spawning period has not resulted in a noticeable decline in stock production. For this reason, it is not likely that the amount of spatial and temporal concentration of fishing effort would inhibit the stock's ability to remain above the MSST.

Status Determination

Model projections of future catches of BSAI and GOA Pacific cod are below their respective overfishing levels in all years under Alternative 1. The BSAI and GOA Pacific cod stocks are above their respective MSSTs in the year 2001.

Age and Size Composition

Under Alternative 1, the mean age of the BSAI Pacific cod stock in 2006, as computed in model projections (Table 4.2-7), is 2.61 years. This compares with a mean age in the equilibrium unfished BSAI stock of 3.20 years.

Under Alternative 1, the mean age of the GOA Pacific cod stock in 2006, as computed in model projections (Table 4.2-8), is 2.73 years. This compares with a mean age in the equilibrium unfished GOA stock of 3.20 years.

Note that the mean ages and sizes actually observed in 2006 (as opposed to the model projections of mean age in 2006) will be driven largely by the strengths of incoming recruitments during the intervening years.

Sex Ratio

The sex ratio of Pacific cod in both the BSAI and GOA is assumed to be 50:50. No information is available to suggest that this would change under Alternative 1.

Habitat-Mediated Impacts

Any habitat-mediated impacts of Alternative 1 would be governed by a complex web of direct and indirect interactions which are difficult to quantify. Information is insufficient to conclude that existing habitat-mediated impacts would undergo significant qualitative change during the next five years under this alternative.

Predation-Mediated Impacts

As with habitat-mediated impacts, any predation-mediated impacts of Alternative 1 on Pacific cod would be governed by a complex web of indirect interactions which are currently difficult to quantify. Information is insufficient to conclude that existing trophic interactions would undergo significant qualitative change during the next five years under Alternative 1.

4.2.3.2 Effects of Alternative 2 on Pacific cod

The slow and low approach calls for several management changes, including:

- Additional closed areas
- A seasonal redistribution of TAC
- TAC reductions to maintain a harvest rate that is proportional to the biomass in the region

Total Biomass

Total (ages 1 through 12+) biomass of BSAI Pacific cod at the start of 2001 is estimated to be 1,508,000 mt. Model projections of future total BSAI biomasses are shown in Table 4.2-7. Under Alternative 2, model projections indicate that total BSAI biomass is expected to increase steadily to a value of 2,162,000 mt by 2006, with a 2001-2006 average value of 1,788,000 mt.

Total biomass of GOA Pacific cod at the start of 2001 is estimated to be 601,400 mt. Model projections of future total GOA biomasses are shown in Table 4.2-8. Under Alternative 2, model projections indicate that total GOA biomass is expected to increase steadily to a value of 762,000 mt by 2006, with a 2001-2006 average value of 670,300 mt.

Spawning Biomass

Spawning biomass of female BSAI Pacific cod at the start of 2001 is estimated to be 383,000 mt. Model projections of future BSAI spawning biomasses are shown in Table 4.2-7. Under Alternative 2, model projections indicate that BSAI spawning biomass is expected to decline to a value of 378,000 mt by 2003, then increase to a value of 468,000 mt by 2006, with a 2001-2006 average value of 404,000 mt. Projected spawning biomass exceeds the B_{MSY} proxy value of 340,000 mt in all years.

Spawning biomass of female GOA Pacific cod at the start of 2000 is estimated to be 102,400 mt. Model projections of future GOA spawning biomasses are shown in Table 4.2-8. Under Alternative 2, model projections indicate that average GOA spawning biomass is expected to decline to a value of 91,700 mt by 2004, and increase to 102,400 mt by 2006, with a 2001-2006 average value of 97,100 mt. Projected spawning biomass exceeds the B_{MSY} proxy value of 79,900 mt in all years.

Fishing Mortality

The average fishing mortality imposed on the BSAI Pacific cod stock in 2001 is 0.111. Model projections show this value will remain fairly stable throughout the projection years. The average fishing mortality levels values are well below the F_{MSY} proxy value of 0.35 which is the rate associated with the overfishing level.

The average fishing mortality imposed on the GOA Pacific cod stock in 2001 is projected to be 0.194 under Alternative 2. Fishing Mortality is projected to be stable throughout the projection time period. The average fishing mortality values are well below the F_{MSY} proxy value of 0.46 which is the rate associated with the overfishing level.

Spatial / Temporal Concentration of Fishing Mortality

Alternative 2 seeks to redistribute Pacific cod catch within the BSAI and GOA. Estimating the likelihood that this goal will be achieved in any single year is difficult because Pacific cod distributions are not static. Bottom trawl and tagging surveys demonstrate that Pacific cod distributions vary considerably on an interannual basis. The distribution of Pacific cod biomass within the BSAI and GOA is dependent on the composition of the stock and environmental conditions. If estimates of underlying Pacific cod distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates within a region. Relative to the GOA, the large shelf area of the EBS could reduce the "race for fish" in the areas that remain open. To mitigate the possibility of disproportional harvest rates in areas remaining open, Alternative 2 calls for the establishment of area-specific TACs proportional to the estimated biomass each area.

Relative to Alternative 1, the Pacific cod fisheries in the EBS and GOA would be expected to have less temporal concentration of catch, and no catch would be allowed from November 1 through December 31. In the short-term, the temporal/seasonal TACs are expected to be taken more quickly than in Alternative 1 because of excess fleet capacity.

If the spatial/temporal partitions correctly map the underlying distribution of Pacific cod with the BSAI and GOA, and the fishing fleet voluntarily re-distributed its effort to adjust for reduced TAC, then Alternative 2 may provide increased protection for Pacific cod. The spatial/temporal partitions would reduce the possibility of overharvesting a portion of the stock.

If the spatial/temporal partitions correctly map the underlying distribution of Pacific cod during the spawning season, this alternative would increase the likelihood of preserving genetic diversity. The spawning populations outside of critical habitat would be harvested at a sustainable rate, and spawning populations within critical habitat would be excluded from commercial harvest during the spawning season.

Status Determination

Model projections of future catches of BSAI and GOA Pacific cod are below their respective overfishing levels in all years under Alternative 2. The BSAI and GOA Pacific cod stocks are above their respective MSSTs in the year 2001.

Age and Size Composition

Under Alternative 2, the mean age of the BSAI Pacific cod stock in 2006, as computed in model projections (Table 4.2-7), is 2.77 years. This compares with a mean age in the equilibrium unfished BSAI stock of 3.20 years.

Under Alternative 2, the mean age of the GOA Pacific cod stock in 2006, as computed in model projections (Table 4.2-8), is 2.82 years. This compares with a mean age in the equilibrium unfished GOA stock of 3.20 years.

Note that the mean ages and sizes actually observed in 2006 (as opposed to the model projections of mean age in 2006) will be driven largely by the strengths of incoming recruitments during the intervening years.

Sex Ratio

The sex ratio of Pacific cod in both the BSAI and GOA is assumed to be 50:50. No information is available to suggest that this would change under Alternative 2.

Habitat-Mediated Impacts

Any habitat-mediated impacts of Alternative 2 would be governed by a complex web of direct and indirect interactions which are difficult to quantify. Information is insufficient to conclude that existing habitat-mediated impacts would undergo significant qualitative change during the next five years under this alternative.

Predation-Mediated Impacts

As with habitat-mediated impacts, any predation-mediated impacts of Alternative 2 on Pacific cod would be governed by a complex web of indirect interactions which are currently difficult to quantify. Information is insufficient to conclude that existing trophic interactions would undergo significant qualitative change during the next five years under Alternative 2.

4.2.3.3 Effects of Alternative 3 on Pacific cod

The restricted and closed area approach calls for several management changes, including:

- An increase in the amount by which the maximum permissible ABC fishing mortality rate is decreased when spawning biomass falls below 40% of the unfished level
- A seasonal redistribution of TAC
- A new sequence of open and closed areas

Total Biomass

Total (ages 1 through 12+) biomass of BSAI Pacific cod at the start of 2001 is estimated to be 1,508,000 mt. Model projections of future total BSAI biomasses are shown in Table 4.2-7. Under Alternative 3, model projections indicate that total BSAI biomass is expected to decrease to 1,442,000 mt in 2002 and increase to a value of 1,920,000 mt by 2006, with a 2001-2006 average value of 1,643,000 mt.

Total biomass of GOA Pacific cod at the start of 2001 is estimated to be 601,400 mt. Model projections of future total GOA biomasses are shown in Table 4.2-8. Under Alternative 3, model projections indicate that total GOA biomass is expected to decrease to 574,400 mt in 2002 and increase to a value of 719,300 mt by 2006, with a 2001-2006 average value of 635,600 mt.

Spawning Biomass

Spawning biomass of female BSAI Pacific cod at the start of 2001 is estimated to be 376,000 mt. Model projections of future BSAI spawning biomasses are shown in Table 4.2-7. Under Alternative 3, model projections indicate that BSAI spawning biomass is expected to decline to a value of 317,000 mt by 2003, then increase to a value of 376,000 mt by 2006, with a 2001-2006 average value of 347,000 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 340,000 mt for the years 2003-2004, but exceeds the B_{MSY} proxy value in 2005 and 2006.

Spawning biomass of female GOA Pacific cod at the start of 2001 is estimated to be 100,200 mt. Model projections of future GOA spawning biomasses are shown in Table 4.2-8. Under Alternative 3, model projections indicate that average GOA spawning biomass is expected to decline to a value of 76,600 t by 2004, then increase to 87,200 mt by 2006, with a 2001-2006 average value of 84,700 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 79,900 mt for the years 2003-2004, but exceeds the B_{MSY} proxy value in 2005 and 2006.

Fishing Mortality

The average fishing mortality imposed on the BSAI Pacific cod stock in 2001 is 0.240. Model projections show average fishing mortality will decrease to 0.183 in 2003 and then increase to 0.206 in 2006. The projected average fishing mortality values are well below the F_{MSY} proxy value of 0.35 which is the rate associated with the overfishing level.

The average fishing mortality imposed on the GOA Pacific cod stock in 2001 is projected to be 0.374 under Alternative 3. Fishing Mortality is projected to decrease to 0.252 in 2004 and then increase to 0.310 in 2006. The average fishing mortality values are well below the F_{MSY} proxy value of 0.46 which is the rate associated with the overfishing level.

Spatial / Temporal Concentration of Fishing Mortality

Alternative 3 seeks to reduce localized depletion by redistributing Pacific cod catch within the AI and EBS. Estimating the likelihood that this goal will be achieved in any single year is difficult because Pacific cod distributions are not static. Bottom trawl and tagging surveys demonstrate that Pacific cod distributions vary considerably on an interannual basis. The distribution of Pacific cod biomass within the BSAI and GOA is dependent on the composition of the stock and environmental conditions. If estimates of underlying Pacific cod distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates within a region. In the EBS, the large shelf area could reduce the "race for fish" within the seasonal TAC allocations.

Relative to Alternative 1, the overall Pacific cod catch in the EBS would be reduced in proportion to the amount of Pacific cod biomass present in closed areas in a given season.

The spatial partitions coupled with the global control rule would increase the likelihood of preserving genetic diversity. In the BSAI and GOA, the closed areas would ensure that some portions of the stock were completely protected from directed fishing. The global control rule would reduce the harvest of Pacific cod in CH beyond the level prescribed by Amendment 56 when spawning stocks are low. These actions are likely to ensure that stocks are harvested at a sustainable rate.

Status Determination

Model projections of future catches of BSAI and GOA Pacific cod are below their respective overfishing levels in all years under Alternative 3. The BSAI and GOA Pacific cod stocks are above their respective MSSTs in the year 2001.

Age and Size Composition

Under Alternative 3, the mean age of the BSAI Pacific cod stock in 2006, as computed in model projections (Table 4.2-7), is 2.65 years. This compares with a mean age in the equilibrium unfished BSAI stock of 3.20 years.

Under Alternative 3, the mean age of the GOA Pacific cod stock in 2006, as computed in model projections (Table 4.2-8), is 2.75 years. This compares with a mean age in the equilibrium unfished GOA stock of 3.20 years.

Note that the mean ages and sizes actually observed in 2006 (as opposed to the model projections of mean age in 2006) will be driven largely by the strengths of incoming recruitments during the intervening years.

Sex Ratio

The sex ratio of Pacific cod in both the BSAI and GOA is assumed to be 50:50. No information is available to suggest that this would change under Alternative 3.

Habitat-Mediated Impacts

Any habitat-mediated impacts of Alternative 3 would be governed by a complex web of direct and indirect interactions which are difficult to quantify. Information is insufficient to conclude that existing habitat-mediated impacts would undergo significant qualitative change during the next five years under this alternative.

Predation-Mediated Impacts

As with habitat-mediated impacts, any predation-mediated impacts of Alternative 3 on Pacific cod would be governed by a complex web of indirect interactions which are currently difficult to quantify. Information is insufficient to conclude that existing trophic interactions would undergo significant qualitative change during the next five years under Alternative 3.

4.2.3.4 Effects of Alternative 4 on Pacific cod

The area- and fishery-specific approach calls for several management changes, including:

- A modified harvest control rule, whereby the directed fishery for Pacific cod in the BSAI would be reduced to zero when the spawning biomass is estimated to be less than 20% of the projected unfished biomass
- A seasonal redistribution of Pacific cod TAC in the BSAI for trawl longline and pot: Three seasons for trawl gear (January 20 (60%), April 1 (20%) and June 11 (20%)); Two seasons for longline gear (January 1 (60%) and June 11 (40%)); Two seasons for pot gear (January 1 (60%) and September 1 (40%))
- A seasonal redistribution of Pacific cod TAC in the GOA for trawl and fixed gear: Two seasons for trawl gear (January 20 (60%) and September 1 (40%)); Two seasons for fixed gear (January 1 (60%) and September 1 (40%))
- Closed areas for BSAI and GOA trawl, pot and longline fisheries
- Prohibition of Pacific cod trawling between November 1 and December 31

Total Biomass

Total (ages 1 through 12+) biomass of BSAI Pacific cod at the start of 2001 is estimated to be 1,508,000 mt. Model projections of future total BSAI biomasses are shown in Table 4.2-7. Under Alternative 4, model projections indicate that total BSAI biomass is expected to decrease to 1,409,000 mt in 2002 and increase to a value of 1,838,000 mt by 2006, with a 2001-2006 average value of 1,585,000 mt.

Total biomass of GOA Pacific cod at the start of 2001 is estimated to be 601,600 mt. Model projections of future total GOA biomasses are shown in Table 4.2-8. Under Alternative 4, model projections indicate that total GOA biomass is expected to decrease to 575,400 mt in 2002 and increase to a value of 709,100 mt by 2006, with a 2001-2006 average value of 631,400 mt.

Spawning Biomass

Spawning biomass of female BSAI Pacific cod at the start of 2001 is estimated to be 374,000 mt. Model projections of future BSAI spawning biomasses are shown in Table 4.2-7. Under Alternative 4, model projections indicate that BSAI spawning biomass is expected to decline to a value of 299,000 mt by 2004, then increase to a value of 351,000 mt by 2006, with a 2001-2006 average value of 330,000 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 340,000 mt for the years 2002-2005, but exceeds the B_{MSY} proxy value in 2006.

Spawning biomass of female GOA Pacific cod at the start of 2001 is estimated to be 100,200 mt. Model projections of future GOA spawning biomasses are shown in Table 4.2-8. Under Alternative 4, model projections indicate that average GOA spawning biomass is expected to decline to a value of 73,400 mt by 2004, then increase to 83,200 mt by 2006, with a 2001-2006 average value of 82,500 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 79,900 t for the years 2003-2005, but exceeds the B_{MSY} proxy value in 2006.

Fishing Mortality

The average fishing mortality imposed on the BSAI Pacific cod stock in 2001 is 0.279. Model projections show average fishing mortality will decrease to 0.219 in 2004 and then increase to 0.227 in 2006. The projected average fishing mortality values are well below the F_{MSY} proxy value of 0.35 which is the rate associated with the overfishing level.

The average fishing mortality imposed on the GOA Pacific cod stock in 2001 is projected to be 0.374 under Alternative 4. Fishing Mortality is projected to decrease to 0.297 in 2004 and then increase to 0.339 in 2006. The average fishing mortality values are well below the F_{MSY} proxy value of 0.46 which is the rate associated with the overfishing level.

Spatial / Temporal Concentration of Fishing Mortality

Alternative 4 seeks to reduce localized depletion by redistributing Pacific cod catch within the BSAI and GOA. Estimating the likelihood that this goal will be achieved in any single year is difficult because Pacific cod distributions are not static. Bottom trawl and tagging surveys demonstrate that Pacific cod distributions vary considerably on an interannual basis. The seasonal distribution of Pacific cod biomass within the BSAI and GOA is dependent on the composition of the stock and environmental conditions. If estimates of

underlying Pacific cod distributions are in error, the spatial/temporal partitions prescribed in this alternative could lead to excessive local harvest rates within a region.

The new seasons prescribed by this alternative are not expected to result in a temporal distribution of catch substantially different than would be obtained under Alternative 1. In the BSAI, 80% of the trawl catch and 60% of the longline and pot catch is allocated to the January season opener. This is similar to current temporal distributions of catch in the region. In the GOA, the temporal shifts would have a slightly greater impact with 60% of the trawl and fixed gear catch allocated to the winter season opener.

Alternative 4 is not expected to result in marked shifts in the spatial distribution of catch. The regions closed to the various gear types are regions that historically have had relatively low levels of fishing effort with those gears.

The spatial partitions coupled with the modified harvest control rule would increase the likelihood of preserving genetic diversity. In the GOA and EBS, the closed areas would ensure that some portion of the stock was protected from directed fishing. The control rule would reduce the harvest of Pacific cod in CH beyond the default level prescribed by Amendment 56 when spawning stocks are low. These actions are likely to ensure that BSAI and GOA cod stocks are harvested at a sustainable rate.

Status Determination

Model projections of future catches of BSAI and GOA Pacific cod are below their respective overfishing levels in all years under Alternative 4. The BSAI and GOA Pacific cod stocks are above their respective MSSTs in the year 2001.

Age and Size Composition

Under Alternative 4, the mean age of the BSAI Pacific cod stock in 2006, as computed in model projections (Table 4.2-7), is 2.67 years. This compares with a mean age in the equilibrium unfished BSAI stock of 3.20 years.

Under Alternative 4, the mean age of the GOA Pacific cod stock in 2006, as computed in model projections (Table 4.2-8), is 2.72 years. This compares with a mean age in the equilibrium unfished GOA stock of 3.20 years.

Note that the mean ages and sizes actually observed in 2006 (as opposed to the model projections of mean age in 2006) will be driven largely by the strengths of incoming recruitments during the intervening years.

Sex Ratio

The sex ratio of Pacific cod in both the BSAI and GOA is assumed to be 50:50. No information is available to suggest that this would change under Alternative 4.

Habitat-Mediated Impacts

Any habitat-mediated impacts of Alternative 4 would be governed by a complex web of direct and indirect interactions which are difficult to quantify. Information is insufficient to conclude that existing habitat-

mediated impacts would undergo significant qualitative change during the next five years under this alternative.

Predation-Mediated Impacts

As with habitat-mediated impacts, any predation-mediated impacts of Alternative 4 on Pacific cod would be governed by a complex web of indirect interactions which are currently difficult to quantify. Information is insufficient to conclude that existing trophic interactions would undergo significant qualitative change during the next five years under Alternative 4.

4.2.3.5 Effects of Alternative 5 on Pacific cod

The critical habitat catch limit approach calls for several management changes, including:

- A seasonal redistribution of TAC
- Additional closed areas, including waters within 10 or 20 nm of 75 haulouts used seasonally or year-round by sea lions

Total Biomass

Total (ages 1 through 12+) biomass of BSAI Pacific cod at the start of 2001 is estimated to be 1,508,000 mt. Model projections of future total BSAI biomasses are shown in Table 4.2-7. Under Alternative 5, model projections indicate that total BSAI biomass is expected to decrease to 1,409,000 mt in 2002 and increase to a value of 1,838,000 mt by 2006, with a 2001-2006 average value of 1,585,000 mt.

Total biomass of GOA Pacific cod at the start of 2001 is estimated to be 601,600 mt. Model projections of future total GOA biomasses are shown in Table 4.2-8. Under Alternative 5, model projections indicate that total GOA biomass is expected to decrease to 575,400 mt in 2002 and increase to a value of 709,100 mt by 2006, with a 2001-2006 average value of 631,400 mt.

Spawning Biomass

Spawning biomass of female BSAI Pacific cod at the start of 2001 is estimated to be 374,000 mt. Model projections of future BSAI spawning biomasses are shown in Table 4.2-6. Under Alternative 5, model projections indicate that BSAI spawning biomass is expected to decline to a value of 299,000 t by 2004, then increase to a value of 351,000 mt by 2006, with a 2001-2006 average value of 330,000 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 340,000 mt for the years 2002-2005, but exceeds the B_{MSY} proxy value in 2006.

Spawning biomass of female GOA Pacific cod at the start of 2001 is estimated to be 100,200 mt. Model projections of future GOA spawning biomasses are shown in Table 4.2-7. Under Alternative 5, model projections indicate that average GOA spawning biomass is expected to decline to a value of 73,400 mt by 2004, then increase to 83,200 mt by 2006, with a 2001-2006 average value of 82,500 mt. Projected spawning biomass dips below the B_{MSY} proxy value of 79,900 mt for the years 2003-2005, but exceeds the B_{MSY} proxy value in 2006.

Fishing Mortality

The average fishing mortality imposed on the BSAI Pacific cod stock in 2001 is 0.279. Model projections show average fishing mortality will decrease to 0.219 in 2004 and then increase to 0.227 in 2006. The projected average fishing mortality values are well below the F_{MSY} proxy value of 0.35 which is the rate associated with the overfishing level.

The average fishing mortality imposed on the GOA Pacific cod stock in 2001 is projected to be 0.374 under Alternative 5. Fishing Mortality is projected to decrease to 0.297 in 2004 and then increase to 0.339 in 2006. The average fishing mortality values are well below the F_{MSY} proxy value of 0.46 which is the rate associated with the overfishing level.

Spatial / Temporal Concentration of Fishing Mortality

Relative to Alternative 1, the Pacific cod fisheries within CH in the BSAI and GOA would be expected to have less catch in the A, B, and D seasons, and no catch would be allowed from November 1 through December 31. Alternative 5 is expected to shift in the spatial distribution of catch away from critical habitat.

The spatial partitions would increase the likelihood of preserving genetic diversity. In the GOA and EBS, the closed areas would ensure that some portion of the stock was protected from directed fishing.

Relative to Alternative 1, the Pacific cod trawl fisheries would be temporally shifted to the spring and summer. This would result in less disturbance of spawning populations. The temporal partitions would increase the likelihood of preserving genetic diversity.

Status Determination

Model projections of future catches of BSAI and GOA Pacific cod are below their respective overfishing levels in all years under Alternative 5. The BSAI and GOA Pacific cod stocks are above their respective MSSTs in the year 2001.

Age and Size Composition

Under Alternative 5, the mean age of the BSAI Pacific cod stock in 2006, as computed in model projections (Table 4.2-7), is 2.67 years. This compares with a mean age in the equilibrium unfished BSAI stock of 3.20 years.

Under Alternative 5, the mean age of the GOA Pacific cod stock in 2006, as computed in model projections (Table 4.2-8), is 2.72 years. This compares with a mean age in the equilibrium unfished GOA stock of 3.20 years.

Note that the mean ages and sizes actually observed in 2006 (as opposed to the model projections of mean age in 2006) will be driven largely by the strengths of incoming recruitments during the intervening years.

Sex Ratio

The sex ratio of Pacific cod in both the BSAI and GOA is assumed to be 50:50. No information is available to suggest that this would change under Alternative 5.

Habitat-Mediated Impacts

Any habitat-mediated impacts of Alternative 5 would be governed by a complex web of direct and indirect interactions which are difficult to quantify. Information is insufficient to conclude that existing habitat-mediated impacts would undergo significant qualitative change during the next five years under this alternative.

Predation-Mediated Impacts

As with habitat-mediated impacts, any predation-mediated impacts of Alternative 5 on Pacific cod would be governed by a complex web of indirect interactions which are currently difficult to quantify. Information is insufficient to conclude that existing trophic interactions would undergo significant qualitative change during the next five years under Alternative 5.

4.2.3.6 Summary of Effects on Pacific cod

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the BSAI and GOA stocks of Pacific cod are outlined in Table 4.2-3. Tables 4.2-9 and 4.2-10 summarize the effects of Alternatives 1 through 5 on Pacific cod stocks in the EBS and GOA. The rating of conditionally significant (either positive or negative) is not applicable in this analysis as the model projections yielded results that were deemed either significant (positive or negative), insignificant, or unknown.

The ratings utilize the MSST as a basis for positive or negative impacts of each alternative. A thorough description of the rationale for the MSST can be found in the National Standard Guidelines 50 CFR Part 600 (Federal Register Vol. 63, No. 84, 24212 - 24237). Under Alternatives 1 - 5, the spawning stock biomass of GOA, and EBS cod is expected to be above the MSST. Overfishing was not allowed for either stock. The EBS and GOA cod stocks are currently above their MSSTs and the expected changes under each alternative are not substantial enough to expect that the genetic diversity of reproductive success of these stocks would change under the new management regime. None of the Alternatives would allow overfishing of the spawning stock therefore the genetic integrity and reproductive potential of the stocks should be preserved.

Table 4.2-9 Summary of effects of Alternatives 1 through 5 on Pacific cod in the eastern Bering Sea

Eastern Bering Sea Pacific Cod	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.2-10 Summary of effects of Alternatives 1 through 5 on Pacific cod in the Gulf of Alaska.

GOA Pacific cod	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative.

4.2.4 Effects of the Alternatives on Atka mackerel

The projected impact on average Atka mackerel yield differs between alternatives. Projected average BSAI Atka mackerel yield (2001-2006) for the alternatives ranges from 35,000 to 88,000 mt. Alternative 2 is projected to provide the lowest average yields. Alternative 5 is projected to provide the highest average yields, with Alternative 4 projected to provide similar average yields of slightly lower magnitude. Alternative 1 is projected to provide a constant average yield of 68,000 mt, and Alternative 3 is projected to provide a constant average yield of about 65,000 mt. As expected, the projected impact on spawning biomass shows an opposite trend with the highest levels of spawning biomass occurring under Alternative

2 and the smallest levels of spawner biomass occurring under Alternative 5. In all cases, the spawning biomass levels were maintained above the $B_{35\%}$ level (135,000 mt). Projected average total biomass ranges from 700,000 to 984,000 mt for the BSAI. The projected impact on the average age differs little between alternatives, ranging from 2.86 (Alternative 5) to 3.12 (Alternative 2). This lack of contrast in average age is due to the nature of the populations in the short term rather than the lack of contrast among the alternatives. Table 4.2-11 presents five year population model projections of BSAI average catch, ABCs, and biomass estimates for Atka mackerel under Alternatives 1 through 5. Table 4.2-12 presents five year population model projections GOA average catch and of ABC estimates for Atka mackerel under Alternatives 1 through 5.

Table 4.2-11 Bering Sea/Aleutian Islands Atka mackerel. Five year population model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under each alternative in 1000s of mt

Description	Year	Alternative				
		1	2	3	4	5
Catch (1000 tons)	2001	68	35	64	77	86
	2002	68	37	65	81	83
	2003	68	41	65	84	85
	2004	68	44	65	83	85
	2005	68	46	64	84	87
	2006	68	48	64	86	88
	Avg.	68	42	65	83	86
ABC (1000 tons)	2001	108	36	108	108	108
	2002	110	39	110	106	104
	2003	124	45	125	113	111
	2004	138	51	140	121	119
	2005	150	55	152	131	129
	2006	158	58	161	140	137
	Avg.	131	47	133	120	118
Spawning Biomass (tons)	2001	173	181	174	171	169
	2002	171	189	173	164	161
	2003	182	209	185	169	165
	2004	198	230	202	178	174
	2005	213	247	217	188	184
	2006	224	260	229	197	193
	Avg.	194	219	197	178	174
Total Biomass (tons)	2001	704	704	704	700	700
	2002	744	774	748	723	714
	2003	795	847	801	755	746
	2004	840	907	848	789	781
	2005	878	952	887	821	813
	2006	907	984	918	847	838
	Avg.	811	861	818	773	765
Fishing mortality	2001	0.212	0.105	0.199	0.242	0.274
	2002	0.208	0.102	0.195	0.257	0.270
	2003	0.182	0.096	0.170	0.255	0.263
	2004	0.161	0.091	0.151	0.237	0.247
	2005	0.148	0.089	0.138	0.225	0.236
	2006	0.140	0.087	0.130	0.216	0.225
	Avg.	0.175	0.095	0.164	0.239	0.253
Avg. age 2006		2.94	3.12	2.96	2.88	2.86
Equil. avg. age $F=0$		3.80	3.80	3.80	3.80	3.80
Equil. avg. age F_{40}		2.53	2.53	2.53	2.53	2.53

Note: Average projected age in 2006 is also given for each alternative

Table 4.2-12 Gulf of Alaska Atka mackerel. Five year population model projections of average catch, and ABC (Acceptable Biological Catch)

Description	Year	Alternative				
		1	2	3	4	5
Catch (tons)	2001	100	0	100	100	200
	2002	100	0	100	100	200
	2003	100	100	100	100	200
	2004	100	100	200	100	200
	2005	100	100	200	100	200
	2006	100	100	100	200	300
ABC (tons)	2001	600	600	600	600	600
	2002	600	600	600	600	600
	2003	600	600	600	600	600
	2004	600	600	600	600	600
	2005	600	600	600	600	600
	2006	600	600	600	600	600

Note: Values are in mt. Zeros represent values less than 50 mt.

4.2.4.1 Effects of Alternative 1 on Atka mackerel

Under the current management regime - Alternative 1, which is described in the preceding section, the general impacts of fishing mortality within Amendment 56/56 ABC/OFL definitions are discussed in Section 2.7.4 of the programmatic EIS, and apply to BSAI and Gulf of Alaska Atka mackerel.

Projections of spawning biomass, total biomass, and expected catch were made through 2006 to examine the short-term impact of each alternative on the BSAI Atka mackerel stock (Table 4.2-11). Age structured models were not available for evaluation of impacts for the Gulf of Alaska, so biomass projections were not produced. The projections start with the vector of 2001 numbers at age estimated in the most recent assessment (Lowe et al. 2000). Spawning biomass is computed in each year based on the time of peak spawning (August) and the maturity and weight schedules described in the assessment.

Catch

The average expected yield for BSAI Atka mackerel for the period 2001-2006 was 68,000 mt (Table 4.2-11). Although ABC is projected to increase over this time period, the actual catch remains constant given the restrictions on fishing inside critical habitat which encompasses the bulk of the major Atka mackerel fishing grounds.

The current Gulf of Alaska ABC and TAC level is 600 mt. This low level of TAC is intended to preclude a directed fishery and only provide for bycatch in other fisheries. This harvest strategy has been applied to GOA Atka mackerel since 1997 as a conservative measure to accommodate the lack of a reliable current estimate of biomass, and that GOA Atka mackerel may be particularly vulnerable to fishing pressure because of its patchy distribution and sporadic recruitment patterns (Lowe and Fritz 1999a).

Projections of Gulf of Alaska Atka mackerel catch under Alternative 1 indicate that catches will likely average 100 mt through 2006 (Table 4.2-12). Annual changes in the GOA catches of Atka mackerel reflect shifts in catches of other species which catch Atka mackerel as bycatch (Pacific Ocean perch, pollock, northern rockfish, and Pacific cod).

Total biomass

In the BSAI, average total biomass will increase 29% from 704,000 mt in 2001 to 907,000 mt in 2006 (Table 4.2-11).

Spawning biomass

The projections for BSAI Atka mackerel indicated that the expected spawning and total biomass would increase. Spawning biomass would increase 29% from 173,000 mt in 2001 to 224,000 mt in 2006 (Table 4.2-11).

Status Determination

Atka mackerel in the BSAI fall within Tier 3a of the ABC/OFL definitions, while in the Gulf of Alaska they are in Tier 6. The Atka mackerel ABCs and TACs are lower than the maximum prescribed under the definitions ($F_{40\%}$, 75% of the average catch from 1978 to 1995 for the BSAI and Gulf of Alaska, respectively), thus, the Alternative 1 impacts of fishing mortality provide lower risks of overfishing relative to the maximum prescribed in Amendment 56.

The average fishing mortality rate for the BSAI Atka mackerel stock was 0.175 which is well below the F_{OFL} level.

In the BSAI, the female spawning biomass in 2001 is estimated to be 173,000 mt which is above the estimated $B_{35\%}$ equal to 135,000 mt, and is projected to remain above $B_{35\%}$ in all projection years. Thus BSAI Atka mackerel is above its MSST and is not overfished or approaching an overfished condition.

Size and age composition

The current age and size compositions of BSAI Atka mackerel are described in Section 3.2.3. The projection model estimated a mean age in 2006 of 2.94 for Alternative 1. This compares with a mean age in the equilibrium unfished BSAI Atka mackerel stock of 3.8 years. The dominating factor determining the current age composition is the magnitude of the recruiting year classes. The selectivity of the fishery has cumulative impacts on the age composition due to fishing mortality, and the current composition is also the result of its being a fished population with a greater than 30-year catch history. In the short term however, the impacts of the current fishing mortality levels on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. The cumulative long-term impacts of the fishing mortality rates could cause a shift in the age and size compositions.

The current age and size distributions of GOA Atka mackerel are described in Section 3.2.3. Because the level of catch is so low and projected to remain at about the same level, it is unlikely that the age and size compositions would change in the future under Alternative 1. Changes in the age and size compositions are more likely driven by variation in recruitment than to the direct (due to removals) or indirect effects (due to changes in community structure or levels of competition and predation) of fishing.

Sex ratio

A 50:50 sex ratio is assumed for the BSAI Atka mackerel assessment and projections. It is unknown what the true population sex ratio is, and what change, if any, would occur in the future. The current population

sex ratio of GOA Atka mackerel is unknown. The true GOA population sex ratio, and what changes, if any, would occur in the future is unknown.

Spatial temporal concentration and habitat mediated - impacts

The directed fishery for Atka mackerel is prosecuted by catcher-processor bottom trawlers. The patterns of the fishery generally reflect the behavior of the species in that the fishery is highly localized, occurring in the same few locations each year, generally occurs at depths between 100 and 200 m (Lowe and Fritz 1999a). Detailed descriptions of the current directed fishery are in Sections 2.5.1 and 2.5.2. The localized pattern of fishing for Atka mackerel apparently does not affect fishing success from one year to the next since local populations in the Aleutian Islands appear to be replenished by immigration and recruitment. In addition, management measures are in place which have the effect of spreading out the harvest in time and space. The overall BSAI TAC is allocated to three management areas (Western, Central, and Bering Sea/Eastern Aleutians). The regional TACs are further allocated to two seasons and there are limits to the amount of catch that can be taken inside of Steller sea lion critical habitat. Because Steller sea lion critical habitat overlaps significantly with Atka mackerel habitat, these measures provide protection to Atka mackerel by reducing the risk of localized depletion and providing habitat protection through effort limitations and reductions.

Atka mackerel have been shown to be a highly mixed population from a genetic standpoint. No evidence of subpopulations were found in a genetic study by Lowe et al. (1998). The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 1 is therefore not likely to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated - impacts

The trophic interactions of Atka mackerel are described in Section 3.2.3. In a study conducted by Yang (1996), more than 90% of the total stomach contents weight of Atka mackerel in the study was made up of invertebrates, with less than 10% made up of fish. The current levels and distribution of harvest do not appear to impact prey availability such that it affects the sustainability of the stock as measured by the ability of the stock to maintain itself above its MSST.

4.2.4.2 Effects of Alternative 2 on Atka mackerel

The slow and low approach calls for several management changes. Of these the most notable changes for Atka mackerel include:

- Closed areas for BSAI fisheries;
- Four seasons with equal seasonal TAC apportionment;
- TAC reductions such that the maximum TAC would be established at 33% of the maximum ABC.

Catch

As prescribed by the alternative, Atka mackerel catches in the BSAI are significantly reduced under Alternative 2 (Table 4.2-11). The expected Atka mackerel catch in 2006 is 48,000 mt.

In the BSAI, the largest amount of discards of Atka mackerel occur in the directed Atka mackerel fishery. Lower catch levels for the directed Atka mackerel fishery would lower the amount of bycatch (discards) of Atka mackerel caught in the directed fishery.

Catches of Gulf of Alaska Atka mackerel are slightly reduced under Alternative 2, to less than 50 mt in 2001 and 2002, and 100 mt from 2003 to 2006.

Total biomass

In the BSAI, total biomass is expected to increase 40% from 704,000 mt in 2001 to 984,000 mt in 2006.

Spawning biomass

In the absence of compensatory processes, reductions in catch will lead to increased spawning potential (Table 4.2-11). Under Alternative 2, the expected average spawning biomass increases 44% from 181,000 mt in 2001 to 260,000 mt in 2006.

Status determination

Spawning biomass levels are maintained above $B_{35\%}$, thus the BSAI Atka mackerel stock is not overfished.

For BSAI Atka mackerel, the projected average fishing mortality rate for the period 2001 - 2006 was 0.095 which is below F_{OFL} .

Size and age composition

Alternative 2 could have an impact on the size and age compositions of BSAI Atka mackerel as catches are significantly reduced relative to Alternative 1. The projection model estimated a mean age in 2006 of 3.12. This compares with a mean age of 2.94 estimated for Alternative 1, and 3.8 estimated for the unfished BSAI Atka mackerel stock. There will be reduced fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of lower fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of lower fishing mortality rates could cause a shift in the age and size compositions.

Because the level of Gulf of Alaska Atka mackerel catches are so low and projected to remain at a low level, it is unlikely that the age and size compositions would change in the future under Alternative 2. Changes in the age and size compositions are more likely driven by variation in recruitment than to the direct (due to removals) or indirect effects (due to changes in community structure or levels of competition and predation) of fishing.

Sex ratio

A 50:50 sex ratio is assumed for the BSAI Atka mackerel assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 2. The current population sex ratio of GOA Atka mackerel is unknown. The true GOA population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 2.

Spatial temporal concentration and habitat mediated impacts

Alternative 2 seeks to temporally and spatially redistribute a much lower level of Atka mackerel catch within the BSAI. Relative to Alternative 1 under which the Atka mackerel fishery is prosecuted in two seasons, there would be expected changes in the spatial and temporal distributions of the Atka mackerel fishery by area and season to accommodate the additional seasons and area closures. Seasonally, the Atka mackerel fishery would be expected to have less catch in the A, B, and D seasons, and no harvest would be allowed from November 1 through December 31, resulting in lower projected yields relative to Alternative 1.

There is significant overlap between the Aleutian Islands Atka mackerel fishing grounds and Steller sea lion foraging habitat, and large areas will be closed to Atka mackerel fishing under Alternative 2. These closures encompass most of the Atka mackerel fishing grounds. Because the area closures are accompanied by a TAC reduction there will be a significant decline in catch and the remaining catch will be distributed out of the closed areas and winter/fall season to the open areas and into spring/summer season. It is unknown whether these remaining open areas will be subject to higher local fishing mortality given the TAC reductions. There will be reduced catches during the summer spawning season for Atka mackerel C and D seasons. Overall, the reduced catch levels, the reduced catches during the spawning season, and the seasonal distribution of catch may serve to provide increased protection to Atka mackerel.

Because of the reduced catches during the spawning season and the likelihood that the area closures encompass Atka mackerel spawning habitat, this alternative would increase the potential for preserving genetic diversity. The spawning populations outside of critical habitat would be harvested at a sustainable rate, and spawning populations within critical habitat would be excluded from commercial fishing harvest during the spawning season.

In the BSAI, under Alternative 2, the temporal and spatial aggregation of fishing would be reduced. Given the lack of evidence for genetically distinct subpopulations, the level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 2 is not likely to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Because GOA Atka mackerel is not a directed fishery and catch levels are so low, it is presumed that overall, the spatial temporal and habitat impacts of Alternative 2 will be essentially the same as described for Alternative 1.

Predator mediated impacts

Lower catches of Atka mackerel, pollock and Pacific cod would impact the amounts of Atka mackerel available to the ecosystem. Under Alternative 2, more commercial sized Atka mackerel would be available as prey and predators in the ecosystem. Atka mackerel are an important component in the diet of Pacific cod. Lower catches of Pacific cod could increase their predation on Atka mackerel. General information on the

trophic interactions of Atka mackerel in the Aleutian Islands are described in Section 3.2.3. Shifts in these interactions are difficult to predict because of the complex nature of the food web. In a study conducted by Yang (1996), more than 90% of the total stomach contents weight of Atka mackerel in the study was made up of invertebrates, with less than 10% made up of fish. Based on the low proportion of fish found in the diet of Atka mackerel, it is presumed that Alternative 2 will not impact prey availability for BSAI and GOA Atka mackerel. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.4.3 Effects of Alternative 3 on Atka mackerel

The restricted and closed area approach calls for several management changes. The most notable include:

- A modified harvest control rule, whereby the recommended fishing mortality rate for BSAI Atka mackerel would be reduced more rapidly than the default rate under Amendment 56 when the spawning biomass is estimated to be less than 40% of the projected unfished biomass, such that the reduction would result in no directed fishing for Atka mackerel when the spawning biomass is estimated to be less than 20% of the projected unfished biomass;
- A seasonal redistribution of Atka mackerel TAC;
- A sequence of open and closed areas for BSAI fisheries;

Catch

Relative to Alternative 1, Atka mackerel catches in the BSAI are slightly lower under Alternative 3 (Table 4.2-11). The expected Atka mackerel catch in 2006 is 64,000 mt.

The largest amount of discards of Atka mackerel occur in the directed BSAI Atka mackerel fishery. Lower catches of Atka mackerel in critical habitat would lower the amount of bycatch (discards) of Atka mackerel caught in the directed fishery.

Catches of Gulf of Alaska Atka mackerel remain at a low level averaging about 100 mt similar to Alternative 1. Because GOA Atka mackerel is not a directed fishery and catch levels are so low, it is presumed that overall, the impacts of Alternative 3 will be essentially the same as described for Alternative 1.

Total biomass

In the BSAI, total biomass is expected to increase 30% from 704,000 mt in 2001 to 918,000 mt in 2006 (Table 4.2-11).

Spawning biomass

Under Alternative 3, the expected average spawning biomass increases 32% from 174,000 mt in 2001 to 229,000 mt in 2006 (Table 4.2-11).

Status determination

For BSAI Atka mackerel, the projected average fishing mortality rate for the period 2001 - 2006 was 0.164, which is below F_{OFL} .

Spawning biomass levels are maintained above $B_{35\%}$, thus the BSAI Atka mackerel stock is not overfished.

Spatial temporal concentration

Alternative 3 seeks to reduce localized depletion by temporally and spatially redistributing Atka mackerel catch within the BSAI. The overall Atka mackerel catch in the BSAI would be reduced in proportion to the amount of Atka mackerel biomass present in closed areas in a given season. Relative to Alternative 1 under which the Atka mackerel fishery is prosecuted in two seasons, there would be expected changes in the spatial and temporal distributions of the Atka mackerel fishery by area and season to accommodate the additional seasons and area closures.

There is significant overlap between the Aleutian Islands Atka mackerel fishing grounds and Steller sea lion critical habitat, and large areas will be closed to Atka mackerel fishing under Alternative 3. These closures encompass most of the Atka mackerel fishing grounds. There will be reduced catches during the summer spawning season for Atka mackerel in critical habitat (C and D seasons). Overall, the reduced catch levels, the reduced catches during the spawning season, and the seasonal distribution of catch inside critical habitat may serve to provide increased protection to Atka mackerel.

Because of the reduced catches during the spawning season, the likelihood that the area closures encompass Atka mackerel spawning habitat, coupled with the global control rule, this alternative could increase the potential for preserving genetic diversity. In the BSAI, the closed areas would ensure that some portions of the stock were completely protected from directed fishing. The global control rule would reduce the harvest of Atka mackerel in critical habitat beyond the level prescribed by Amendment 56 when spawning stocks were low. These actions are likely to ensure that BSAI Atka mackerel are harvested at a sustainable rate.

Under Alternative 3, the temporal and spatial aggregation of fishing would be reduced. Given the lack of evidence for genetically distinct subpopulations, the level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 3 is not likely to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Size and age composition

Alternative 3 could have an impact on the size and age compositions of BSAI Atka mackerel similar to Alternative 1 as catch levels are similar. The projection model estimated a mean age in 2006 of 2.96. This compares with a mean age of 2.94 estimated for Alternative 1, and 3.8 estimated for the unfished BSAI Atka mackerel stock. Relative to Alternative 1, there will be a similar level of fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of fishing mortality rates could cause a shift in the age and size compositions.

Because the level of Gulf of Alaska Atka mackerel catches are so low and projected to remain at a low level, it is unlikely that the age and size compositions would change in the future under Alternative 3. Changes in the age and size compositions are more likely driven by variation in recruitment than to the direct (due to removals) or indirect effects (due to changes in community structure or levels of competition and predation) of fishing.

Sex ratio

A 50:50 sex ratio is assumed for the BSAI Atka mackerel assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 3. The current population sex ratio of GOA Atka mackerel is unknown. The true GOA population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 3.

Predation mediated impacts

Lower catches of Atka mackerel in critical habitat would impact the amounts of Atka mackerel available to the ecosystem. Under Alternative 3, more commercial sized Atka mackerel would be available as prey and predators in critical habitat. Atka mackerel are an important component in the diet of Pacific cod. Lower catches of Pacific cod could increase their predation on Atka mackerel. General information on the trophic interactions of Atka mackerel in the Aleutian Islands are described in Section 3.2.3. Shifts in these interactions are difficult to predict because of the complex nature of the food web. In a study conducted by Yang (1996), more than 90% of the total stomach contents weight of Atka mackerel in the study was made up of invertebrates, with less than 10% made up of fish. Based on the low proportion of fish found in the diet of Atka mackerel, it is presumed that Alternative 3 will not impact prey availability for BSAI and GOA Atka mackerel. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.4.4 Effects of Alternative 4 on Atka mackerel

The area and fishery specific approach calls for several management changes. The most notable include:

- A modified harvest control rule, whereby the directed fishery for Atka mackerel in the BSAI would be reduced to zero when the spawning biomass is estimated to be less than 20% of the projected unfished biomass;
- A seasonal redistribution of Atka mackerel TAC: January 20 (50%) and September 1 (50%)
- TAC would be further apportioned inside and outside of critical habitat, with 60% inside and 40% outside;
- No fishing for Atka mackerel in critical habitat east of 178° West longitude;
- Closed areas for BSAI fisheries, including 10 nm no trawl zones around rookeries west of 178° West longitude, and 0-15 nm at Buldir;

Catch

Relative to Alternative 1, Atka mackerel catch in the BSAI are higher under Alternative 4 (Table 4.2-11). The expected average Atka mackerel catch from 2001 to 2006 is 83,000 mt, and the expected catch in 2006 is 86,000 mt.

In the BSAI, the largest amount of discards of Atka mackerel occur in the directed Atka mackerel fishery. Higher catch levels for the directed Atka mackerel fishery could increase the amount of bycatch (discards) of Atka mackerel caught in the directed fishery.

Catches of Gulf of Alaska Atka mackerel remain at a low level averaging about 100 mt similar to Alternative 1. Because GOA Atka mackerel is not a directed fishery and catch levels are so low, it is presumed that overall, the impacts of Alternative 4 will be essentially the same as described for Alternative 1.

Total biomass

In the BSAI, total biomass is expected to increase 21% from 700,000 mt in 2001 to 847,000 mt in 2006.

Spawning biomass

In the absence of compensatory processes, increases in catch lead to an initial decrease in spawning potential (Table 4.2-11). Under Alternative 4, the expected average spawning biomass in the BSAI decreases from 171,000 mt in 2001 to 164,000 mt in 2002, after which spawning biomass increases to 197,000 mt by 2006.

Status determination

The projected average fishing mortality rate for the period 2001 - 2006 was 0.24 which is below F_{OFL} .

Spawning biomass levels are maintained above $B_{35\%}$, thus the BSAI Atka mackerel stock is not overfished.

Size and age composition

Alternative 4 could have an impact on the size and age compositions of BSAI Atka mackerel as catches are increased relative to Alternative 1. The projection model estimated a mean age in 2006 of 2.88. This compares with a mean age of 2.94 estimated for Alternative 1, and 3.8 estimated for the unfished BSAI Atka mackerel stock. There will be increased fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of higher fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes, which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of higher fishing mortality rates could cause a shift in the age and size compositions.

Because the level of Gulf of Alaska Atka mackerel catches are so low and projected to remain at a low level, it is unlikely that the age and size compositions would change in the future under Alternative 4. Changes in the age and size compositions are more likely driven by variation in recruitment than to the direct (due to removals) or indirect effects (due to changes in community structure or levels of competition and predation) of fishing.

Sex ratio

A 50:50 sex ratio is assumed for the BSAI Atka mackerel assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 4. The current population sex ratio of GOA Atka mackerel is unknown. The true GOA population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 4.

Spatial temporal concentration and habitat mediated impacts

Alternative 4 seeks to reduce localized depletion by redistributing Atka mackerel catch within the BSAI. Alternative 1, and Alternative 4 have some similar measures (two season with the same starting dates, and catch limits within critical habitat). Thus, the expected changes in the spatial and temporal distributions of

the Atka mackerel fishery under Alternative 4 relative to Alternative 1 would not be expected to be large. Under Alternative 4 however, the TAC is apportioned 60% inside critical habitat and 40% outside, which compares to Alternative 1 which has TAC apportioned 40% inside critical habitat and 60% outside. Thus, under Alternative 4 there is the potential for increased effort inside critical habitat relative to Alternative 1, and projected yields under Alternative 4 are higher relative to Alternative 1.

Although catches are expected to increase under this alternative, the modified harvest control rule could serve to increase protection to Atka mackerel spawning biomass, and increase the potential for preserving genetic diversity. The global control rule would reduce the harvest of Atka mackerel beyond the level prescribed by Amendment 56 when spawning stocks were extremely low. However, it is unlikely that the Atka mackerel stocks would reach these levels unless a strong tendency for prolonged periods of weak year classes develops in this population.

Under Alternative 4, the spatial aggregation of fishing could increase as a result of increased effort in critical habitat. Given the lack of evidence for genetically distinct subpopulations, the moderately increased level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 4 is not likely to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST. However, any large changes in fishing effort in local areas would be a concern.

Predator mediated impacts

Higher catches of Atka mackerel in critical habitat would impact the amounts of Atka mackerel available to the ecosystem. Under Alternative 4, fewer commercial sized Atka mackerel would be available as prey and predators in critical habitat. Atka mackerel are an important component in the diet of Pacific cod. Any changes in the catch of Pacific cod could change their level of predation on Atka mackerel. General information on the trophic interactions of Atka mackerel in the Aleutian Islands are described in Section 3.2.3. Shifts in these interactions are difficult to predict because of the complex nature of the food web. In a study conducted by Yang (1996), more than 90% of the total stomach contents weight of Atka mackerel in the study was made up of invertebrates, with less than 10% made up of fish. Based on the low proportion of fish found in the diet of Atka mackerel, it is presumed that Alternative 4 will not impact prey availability for BSAI and GOA Atka mackerel. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.4.5 Effects of Alternative 5 on Atka mackerel

The critical habitat catch limit approach calls for essentially the same management measures as Alternative 1 for Atka mackerel:

- Two seasons with TAC apportionments established: January 20-April 15 (50%) and September 1-October 32 (50%);
- Harvest limits established in critical habitat: 40% inside critical habitat, and 60% outside;
- Closed areas for BSAI fisheries, within 10 or 20 nm of 75 haulouts seasonally or year-round on use by sea lions.

Catch

Although management measures are similar to those imposed under Alternative 1, catches of BSAI Atka mackerel are projected to be higher relative to Alternative 1. The model, which assumes a complex set of linkages among fisheries, projects that the Atka mackerel fishery would attain a larger portion of the TAC under Alternative 5. The expected average Atka mackerel catch from 2001 to 2006 is 86,000 mt, and the expected catch in 2006 is 88,000 mt.

In the BSAI, the largest amount of discards of Atka mackerel occur in the directed Atka mackerel fishery. Higher catch levels for the directed Atka mackerel fishery could increase the amount of bycatch (discards) of Atka mackerel caught in the directed fishery.

Catches of Gulf of Alaska Atka mackerel remain at a low level averaging about 200 mt. Because GOA Atka mackerel is not a directed fishery and catch levels are so low, it is presumed that overall, the impacts of Alternative 5 will be essentially the same as described for Alternative 1.

Total biomass

Total biomass increases 20% from 700,000 mt in 2001 to 838,000 mt in 2006.

Spawning biomass

In the absence of compensatory processes, increases in catch lead to an initial decrease in spawning potential (Table 4.2-11). Under Alternative 5, the expected average spawning biomass in the BSAI decreases from 169,000 mt in 2001 to 161,000 mt in 2002, after which spawning biomass increases to 193,000 mt by 2006.

Status determination

The projected average fishing mortality rate for the period 2001 - 2006 was 0.25 which is below F_{OFL} .

Spawning biomass levels are maintained above $B_{35\%}$, thus the BSAI Atka mackerel stock is not overfished.

Spatial temporal concentration

Under Alternative 5, the spatial aggregation of fishing could increase as a result of increased effort. Given the lack of evidence for genetically distinct subpopulations, the moderately increased level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 5 is not likely to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST. However, any large changes in fishing effort in local areas would be of concern.

Size and age composition

Alternative 5 could have an impact on the size and age compositions of BSAI Atka mackerel as catches are higher relative to Alternative 1. The projection model estimated a mean age in 2006 of 2.86. This compares with a mean age of 2.94 estimated for Alternative 1, and 3.8 estimated for the unfished BSAI Atka mackerel stock. There will be increased fishing pressure on fish 3 to 10 years old. In the short-term, the impacts of higher fishing mortality on the stock would be overshadowed by the magnitude of incoming year classes,

which in turn are highly dependent on environmental conditions. However, the cumulative long-term impacts of higher fishing mortality rates could cause a shift in the age and size compositions.

Because the level of Gulf of Alaska Atka mackerel catches are so low and projected to remain at a low level, it is unlikely that the age and size compositions would change in the future under Alternative 5. Changes in the age and size compositions are more likely driven by variation in recruitment than to the direct (due to removals) or indirect effects (due to changes in community structure or levels of competition and predation) of fishing.

Sex ratio

A 50:50 sex ratio is assumed for the BSAI Atka mackerel assessments and projections. The true population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 5. The current population sex ratio of GOA Atka mackerel is unknown. The true GOA population sex ratio, and what changes, if any, would occur in the future is unknown under Alternative 5.

Predation mediated impacts

Higher catches of Atka mackerel in critical habitat would impact the amounts of Atka mackerel available to the ecosystem. Under Alternative 5, fewer commercial sized Atka mackerel would be available as prey and predators in critical habitat. Atka mackerel are an important component in the diet of Pacific cod. Any changes in the catch of Pacific cod could increase or decrease their predation on Atka mackerel. General information on the trophic interactions of Atka mackerel in the Aleutian Islands are described in Section 3.2.3. Shifts in these interactions are difficult to predict because of the complex nature of the food web. In a study conducted by Yang (1996), more than 90% of the total stomach contents weight of Atka mackerel in the study was made up of invertebrates, with less than 10% made up of fish. Based on the low proportion of fish found in the diet of Atka mackerel, it is presumed that Alternative 5 will not impact prey availability for BSAI and GOA Atka mackerel. The impacts are unlikely to result in a change in prey availability such that it jeopardizes the stock to sustain itself above the MSST.

4.2.4.6 Summary of Effects on Atka mackerel

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the BSAI and GOA stocks of Atka mackerel are outlined in Table 4.2-3. Tables 4.2-13 and -14 summarize the effects of Alternatives 1 through 5 on Atka mackerel in the BSAI and GOA.

Table 4.2-13 Summary of effects of Alternatives 1 through 5 on BSAI Atka mackerel.

BSAI Atka mackerel	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.2-14 Summary of effects of Alternatives 1 through 5 on Atka mackerel in the Gulf of Alaska.

GOA Atka mackerel	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	U	U	U	U	U
Spatial temporal concentration of catch	U	U	U	U	U
Indirect Effects					
Change in prey availability	U	U	U	U	U
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Because the mean (2001-2006) BSAI Atka mackerel fishing mortality rates for ABC are below the overfishing mortality rate for all the alternatives, the fishing mortality effect is insignificant for all alternatives. For all other effects, it was determined that none of the alternatives jeopardize the ability of BSAI Atka mackerel to sustain itself at or above the MSST, and the effects were insignificant for all alternatives.

The ratings utilize the MSST as a basis for positive or negative impacts of each alternative. A thorough description of the rationale for the MSST can be found in the National Standard Guidelines 50 CFR Part 600 (Federal Register Vol. 63, No. 84, 24212 - 24237). Under Alternatives 1 - 5, the spawning stock biomass of Gulf of Alaska, and BSAI Atka mackerel is expected to be above the MSST. Under all alternatives the fishing mortality rate is set below $F_{0.1}$ therefore the probability that overfishing would occur is low for the BSAI and GOA stocks. The BSAI and Gulf of Alaska Atka mackerel stocks are currently above their MSSTs and the expected changes under each alternative are not substantial enough to expect that the genetic diversity or reproductive success of these stocks would change under the alternative management regime. None of the alternatives would allow overfishing of the spawning stock therefore the genetic integrity and reproductive potential of the stocks should be preserved.

The fishing mortality rate for GOA Atka mackerel is unknown, thus the effect of fishing mortality is unknown for all alternatives. As the MSST cannot be estimated for GOA Atka mackerel which are in Tier 6, the significance of all other effects are also unknown for all the alternatives.

4.2.5 Effects of the Alternatives on Other Target Species

4.2.5.1 Flatfish Species

It is not surprising that management measures designed to constrain pollock, Pacific cod, and Atka mackerel catches have no significant impact on flatfish populations and only minor impact on flatfish fisheries. Since flatfish distributions in the Bering Sea and Gulf of Alaska overlap with Pacific cod, the projected catch of flatfish under the various alternatives are indirectly affected by the spatial/temporal partitioning of the cod harvest to preserve more cod for sea lions. Projected average combined flatfish yield (2001-2006) for the alternatives ranges from 74,000 - 201,000 mt in the Bering Sea and 26,000-62,000 mt in the Gulf of Alaska. Lowest average yields are projected from Alternative 2 in the Bering Sea and Alternative 3 in the Gulf of Alaska. The other alternatives provide catch of about the same magnitude in each sea area with Alternative 5 projected to provide the highest yields in the Bering Sea and Alternative 1 in the Gulf of Alaska.

In all alternatives the projected impact on flatfish populations is minor as the projected spawning biomass is expected to remain well above the $B_{35\%}$ levels and the average age in the flatfish populations would not change. Projected fishing mortality values are well below F_{OFL} for each flatfish species in each alternative. Table 4.2-15 presents five year population model projections of average catch, ABC and biomass estimates for flatfish in the EBS under Alternatives 1 through 5. Table 4.2-16 presents five year population model projections of average catch, ABC, and biomass estimates (for arrowtooth flounder only) for flatfish in the GOA under Alternatives 1 through 5.

Table 4.2-15 Eastern Bering Sea flatfish. Five year population model projections of average catch, ABC (acceptable biological catch), female spawning biomass and total biomass under each alternative

	Year	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Catch (1000 t)	2001	144	76	90	98	172
	2002	217	76	240	103	226
	2003	217	76	253	103	226
	2004	217	74	242	196	227
	2005	228	73	90	200	192
	2006	92	72	90	177	164
	Avg.	186	75	168	146	201
ABC (1000 t)	2001	895	895	895	895	895
	2002	859	866	865	864	856
	2003	808	829	812	825	804
	2004	761	795	760	789	756
	2005	720	767	716	747	713
	2006	679	738	690	707	676
	Avg.	787	815	790	805	783
Female Spawning biomass (1000 t)	2001	2,939	2,947	2,947	2,946	2,936
	2002	2,824	2,867	2,844	2,860	2,811
	2003	2,664	2,763	2,675	2,750	2,648
	2004	2,502	2,657	2,498	2,623	2,483
	2005	2,354	2,565	2,361	2,480	2,337
	2006	2,229	2,475	2,278	2,344	2,211
	Avg.	2,585	2,712	2,601	2,667	2,571
Total biomass (1000 t)	2001	7,579	7,579	7,579	7,579	7,579
	2002	7,333	7,403	7,387	7,376	7,302
	2003	7,044	7,251	7,072	7,195	7,000
	2004	6,827	7,162	6,817	7,075	6,769
	2005	6,681	7,138	6,647	6,924	6,607
	2006	6,533	7,110	6,640	6,778	6,491
	Avg.	7,000	7,274	7,024	7,155	6,958

Table 4.2-16 Gulf of Alaska flatfish. Five year population model projections of average catch and ABC (acceptable biological catch) under each Alternative

	Year	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Catch (1000 t)	2001	64	63	27	61	61
	2002	65	62	27	61	61
	2003	65	62	26	60	60
	2004	63	60	26	58	57
	2005	58	57	25	40	41
	2006	62	61	26	56	56
	Avg.	63	61	26	56	56
ABC (1000 t)	2001	227	227	227	227	227
	2002	228	228	227	227	227
	2003	228	228	227	227	227
	2004	229	229	228	228	228
	2005	232	231	230	230	230
	2006	234	234	232	232	232
	Avg.	230	230	229	229	229
Arrowtooth flounder female spawning biomass (1000 t)	2001	1,067	1,067	1,067	1,067	1,067
	2002	1,057	1,057	1,055	1,054	1,054
	2003	1,036	1,035	1,030	1,029	1,029
	2004	1,015	1,013	1,005	1,004	1,005
	2005	1,005	1,003	992	991	993
	2006	992	990	977	977	978
	Avg.	1,029	1,028	1,021	1,020	1,021
Arrowtooth flounder total biomass (1000 t)	2001	1,645	1,645	1,645	1,646	1,646
	2002	1,683	1,683	1,681	1,680	1,681
	2003	1,719	1,718	1,712	1,713	1,714
	2004	1,761	1,760	1,750	1,751	1,752
	2005	1,814	1,812	1,799	1,800	1,801
	2006	1,854	1,852	1,836	1,837	1,839
	Avg.	1,746	1,745	1,737	1,738	1,739

Notes: Female spawning biomass and total biomass are only for arrowtooth flounder

4.2.5.1.1 Effects of Alternative 1 on Flatfish Species

Under the current management regime (Alternative 1) Bering Sea flatfish are classified under tier 3 of the Amendment 56/56 ABC/OFL definitions. For each flatfish species in the FMP, the 2001 TAC was set at a level lower than the ABC. Harvest is further restricted by halibut bycatch limits (with the exception of yellowfin sole in recent years) where fisheries have been closed before reaching the TAC because of attainment of the halibut PSC limit.

Catch

In the case of BSAI flatfish, the projected impact of Alternative 1 would be to annually harvest from 14-31% of the combined flatfish ABC from 2001-2006 (Table 4.2-15). The majority of the catch would be yellowfin sole with the other flatfish species caught in amounts far less than their respective ABC values.

For Gulf of Alaska flatfish, ABC and OFL are calculated by species and are classified under tiers 3-6 depending on the amount of information available. Except for deep-water flatfish and rex sole where the 2001 ABC=TAC, the TAC is set at a lower level than the ABC. Harvest in the Gulf of Alaska is also restricted by halibut bycatch limits as in the Bering Sea. The projected impact of Alternative 1 would be to annually harvest from 24-29% of the combined flatfish ABC from 2001-2006 (Table 4.2-16). The largest component of the catch is projected to be shallow-water flatfish (41-48%) with all GOA flatfish caught at levels far less than their respective ABC values.

Spawning biomass

In the BSAI, spawning biomass is projected to decrease 24% from 2.9 to 2.2 million mt, a reflection of the poor recruitment from the 1990s for some flatfish stocks and the length of the projection, rather than a result of Alternative 1 harvest.

In the GOA, spawning and total biomass are only available for arrowtooth flounder (only flatfish in tier 3) which is projected to decrease 7% (from 1.67 to 0.99 million mt) and increase 13% (from 1.645 to 1.854 million mt), respectively.

Total biomass

Total biomass is projected to decrease 14% from 7.58 to 6.53 million mt. All flatfish stocks in the EBS are not overfished and are projected to be above B_{35} through 2006.

Status determination

All flatfish stocks in the BSAI and GOA are not overfished as harvest levels are below the overfishing level.

Fishing mortality rates BSAI or GOA flatfish stocks are below the overfishing level.

4.2.5.1.2 Effects of Alternative 2 on Flatfish Species

Catch

This alternative, which would establish lower levels of ABC for cod, pollock and Atka mackerel is projected to result in the lowest annual Bering Sea flatfish catches over the 5 Alternatives considered. The projected impact of Alternative 2 would be to annually harvest only 9-10% of the combined flatfish ABC from 2001-2006 (Table 4.2-15). About 1/3 of the catch would be yellowfin sole with all flatfish species caught in amounts far less than their respective ABC values.

The projected impact of Alternative 2 for Gulf of Alaska flatfish would be to annually harvest from 25-28% of the combined flatfish ABC from 2001-2006 (Table 4.2-16). The largest component of the catch is

projected to be shallow-water flatfish (41-48%) with all GOA flatfish caught at levels far less than their respective ABC values.

Spawning biomass

In the BSAI, spawning biomass is projected to decrease 16% from 2.9 to 2.47 million mt and the total biomass is projected to decrease 6% from 7.58 to 7.11 million mt.

In the GOA, spawning and total biomass are only available for arrowtooth flounder (only flatfish in tier 3) which is projected to decrease 7% and increase 13%, respectively.

Status determination

Fishing mortality rates BSAI or GOA flatfish stocks are below the overfishing level.

All flatfish stocks in the EBS would not be overfished and are projected to be above B_{35} through 2006.

All flatfish stocks in the GOA would not be overfished as harvest levels are projected to be below the overfishing level.

Spatial temporal concentration and habitat mediated impacts

The provision in this Alternative to prohibit trawling within the SSL critical habitat zone would also displace the rock sole roe fishery from its traditional harvest area. However, these impacts are not expected to have a detectable impact on flatfish reproductive success or genetic diversity.

4.2.5.1.3 Effects of Alternative 3 on Flatfish Species

Catch

The projected impact of Alternative 3 would result in an annual harvest ranging from only 10-32% of the combined flatfish ABC from 2001-2006 (Table 4.2-15). About 1/2 of the catch would be yellowfin sole with all flatfish species caught in amounts far less than their respective ABC values.

The projected impact of Alternative 3 for Gulf of Alaska flatfish would be to annually harvest 11-12% of the combined flatfish ABC from 2001-2006, the lowest level of the 5 alternatives considered (Table 4.2-16). The largest component of the catch is projected to be arrowtooth flounder (47-51%) with all GOA flatfish caught at levels far less than their respective ABC values.

Spawning biomass

In the BSAI, spawning biomass is projected to decrease 23% from 2.9 to 2.28 million mt and the total biomass is projected to decrease 12 from 7.58 to 6.64 million mt.

In the GOA, spawning and total biomass are only available for arrowtooth flounder (the only flatfish in tier 3) which is projected to decrease 8% and increase 11%, respectively.

Status determination

All flatfish stocks in the EBS would not be overfished and are projected to be above B_{35} through 2006. Harvest levels for BSAI flatfish would be below the overfishing level.

All flatfish stocks in the GOA would not be overfished as harvest levels are projected to be below the overfishing level.

Spatial temporal concentration and habitat mediated impacts

This alternative, which would establish large areas of critical habitat where fishing for pollock, cod and Atka mackerel is prohibited would have little effect on flatfish reproductive success or genetic diversity.

4.2.5.1.4 Effects of Alternative 4 on Flatfish Species

Catch

The "the area and fisheries specific approach" is projected to result in the second lowest annual Bering Sea flatfish catch from the 5 alternatives considered. The projected impact of Alternative 4 would be to annually harvest only 11-27% of the combined flatfish ABC from 2001-2006 (Table 4.2-16). About 1/2 of the catch would be yellowfin sole with all flatfish species caught in amounts far less than their respective ABC values.

The projected impact of Alternative 4 for Gulf of Alaska flatfish would be to annually harvest from 17-27% of the combined flatfish ABC from 2001-2006 (Table 4.2-16). The largest component of the catch is projected to be shallow-water flatfish (29-34%) with all GOA flatfish caught at levels far less than their respective ABC values. Spawning and total biomass are only available for arrowtooth flounder (the only flatfish in tier 3) which is projected to decrease 8% and increase 10%, respectively.

Spawning biomass

In the BSAI, spawning biomass is projected to decrease 20% from 2.9 to 2.34 million mt and the total biomass is projected to decrease 10% from 7.58 to 6.78 million mt.

Status determination

All flatfish stocks in the EBS would not be overfished and are projected to be above B_{35} through 2006. Harvest levels for BSAI flatfish would be below the overfishing level.

All flatfish stocks in the GOA would not be overfished as harvest levels are projected to be below the overfishing level.

Spatial temporal concentration

Alternative 4 limits the catch of pollock, cod and Atka mackerel in sea lion critical habitat zones, is expected to have little impact on flatfish reproductive success or genetic diversity.

4.2.4.1.5 Effects of Alternative 5 on Flatfish Species

Catch

The projected impact of Alternative 5 would be to annually harvest only 19-30% of the combined flatfish ABC from 2001-2006 (the highest projected catch of the 5 Alternatives, Table 4.2-16). Over half (56%) of the catch would be yellowfin sole with all flatfish species caught in amounts far less than their respective ABC values.

The projected impact of Alternative 5 for Gulf of Alaska flatfish would be to annually harvest from 18-27% of the combined flatfish ABC from 2001-2006 (Table 4.2-16). The largest component of the catch is projected to be shallow-water flatfish (29-34%) with all GOA flatfish caught at levels far less than their respective ABC values.

Spawning biomass

In the BSAI, spawning biomass is projected to decrease 25% from 2.9 to 2.21 million mt and the total biomass is projected to decrease 14% from 7.58 to 6.49 million mt.

In the GOA, spawning and total biomass are only available for arrowtooth flounder (the only flatfish in tier 3) which is projected to decrease 8% and increase 10%, respectively.

Status determination

All flatfish stocks in the EBS would not be overfished and are projected to be above B_{35} through 2006. Harvest levels for BSAI flatfish would be below the overfishing level.

All flatfish stocks in the GOA would not be overfished as harvest levels are projected to be below the overfishing level.

Spatial temporal concentration

Alternative 5 limits the catch of pollock, cod and Atka mackerel in sea lion critical habitat zones, is expected to have little impact on flatfish reproductive success or genetic diversity.

4.2.5.1.6 Summary of Effects on Flatfish Species

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the BSAI and GOA stocks of flatfish species are outlined in Table 4.2-3. Tables 4.2-17 summarize the effects of Alternatives 1 through 5 on flatfish species in the BSAI and GOA.

Age structured models exist for six BSAI flatfish stocks (yellowfin sole, arrowtooth flounder, rock sole, Greenland turbot, flathead sole and Alaska plaice). These six species are the most abundant species in the BSAI representing the majority of flatfish biomass in the region. The ratings for BSAI flatfish impacts are based on projection model results for these six species. It is likely that the minor flatfish species would be similarly impacted by the alternatives. The ratings utilize the MSST as a basis for positive or negative impacts of each alternative. A thorough description of the rationale for the MSST can be found in the National Standard Guidelines 50 CFR Part 600 (Federal Register Vol. 63, No. 84, 24212 - 24237). Under

Alternatives 1 - 5, the spawning stock biomass of BSAI flatfish is expected to be above the MSST. None of the alternatives would allow fishing mortality to exceed the overfishing level therefore the fishing mortality impacts are rated as insignificant. The six BSAI flatfish species are currently above their MSSTs and the expected changes under each alternative are not substantial enough to expect that the genetic diversity or reproductive success of these stocks would change under the alternative management regime.

None of the alternatives would allow fishing mortality to exceed the overfishing level therefore fishing mortality impacts are rated as insignificant. With the exception of arrowtooth flounder the MSST cannot be estimated for GOA flatfish, the significance of all other effects are also unknown for all the alternatives.

Table 4.2-17 Summary of effects of Alternatives 1 through 5 on flatfish target species in the BSAI and GOA.

Species/Species Groups	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
BSAI yellowfin sole, rock sole, Greenland turbot, flathead sole, arrowtooth flounder, Alaska plaice and GOA arrowtooth flounder					
Direct effects					
Fishing mortality	I	I	I	I	I
Spatial/temporal concentration of catch	I	I	I	I	I
Indirect effects					
Change in prey availability	I	I	I	I	I
Habitat suitability, change in suitability of spawning, nursery, settlement, etc, habitat	I	I	I	I	I
BSAI "other flatfish" (except Alaska plaice), GOA shallow water flatfish, deep water flatfish, rex sole and flathead sole					
Direct effects					
Fishing mortality	I	I	I	I	I
Spatial/temporal concentration of catch	U	U	U	U	U
Indirect effects					
Change in prey availability	U	U	U	U	U
Habitat suitability, change in suitability of spawning, nursery, settlement, etc, habitat	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.2.5.2 Bering Sea/Aleutian Islands Rockfish

A number of management alternatives were evaluated with respect to their projected impacts on three groups of Bering Sea/Aleutian Islands rockfish: Pacific Ocean Perch (POP), other red rockfish (includes sharpchin, northern, rougheye, and shortraker rockfish), and other rockfish. Brief summaries of the objectives and management tools of each alternative are given below; a detailed description is provided in the preceding section. For BSAI POP, projections of spawning biomass, total biomass, catch levels, and fishing mortality rates were made through 2006 using the methods described in Section 4.2.1. In 2001, Bering Sea and Aleutian Islands POP stocks were modeled separately; the results were combined for this discussion. For other red rockfish and other rockfish, only projections for future harvests and acceptable biological catch are available.

Although the alternatives generally do not directly affect rockfish fisheries, it may have indirect effects through rockfish bycatch in the affected fisheries. For example, although approximately 80% of the harvested Aleutian Islands POP occur in directed POP fisheries, about 14% of the harvest occurs in the Atka mackerel fishery. In addition, some of the measures prohibiting trawling in critical habitat would affect the rockfish trawl fisheries. Thus, it is useful to compare projected catch numbers under the Alternatives to assess potential impacts.

Table 4.2-18 presents five year population model projections of average catch, ABC, biomass estimates for POP in the Bering Sea and Aleutian Islands under Alternatives 1 through 5. Table 4.2-19 presents average age, average F , $F_{40\%}$, and equilibrium catch at $F_{40\%}$, for POP in the EBS and AI under Alternatives 1 through 5. Tables 4.2-20 and -21 present projected catch and ABCs for other red rockfish and other rockfish in the BSAI under Alternatives 1 through 5.

Table 4.2-18 Bering Sea/Aleutian Islands Pacific Ocean Perch. Five-year populations model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under Alternatives 1 through 5.

	Year	Alt 1	Alt2	Alt3	Alt4	Alt 5
Catch	2001	10,665	8,165	7,453	7,918	3,956
	2002	12,638	8,031	10,174	7,666	7,541
	2003	11,576	7,902	11,755	7,471	8,629
	2004	10,982	7,944	11,072	9,418	8,805
	2005	10,431	7,966	6,292	9,178	8,193
	2006	10,038	7,932	6,275	7,980	7,259
	Avg.	11,055	7,990	8,837	8,272	7,397
ABC	2001	14,601	14,601	14,601	14,601	14,601
	2002	13,933	14,262	14,316	14,266	14,556
	2003	12,985	13,858	13,626	13,886	14,274
	2004	12,535	13,825	13,123	13,881	14,190
	2005	12,196	13,780	12,721	13,599	13,916
	2006	11,905	13,673	12,773	13,164	13,512
	Avg.	13,026	14,000	13,527	13,900	14,175
Spawning biomass	2001	120,091	120,422	120,491	120,438	120,934
	2002	117,880	119,764	119,749	119,864	121,836
	2003	115,198	119,272	117,906	119,511	121,361
	2004	113,304	119,105	115,880	119,254	120,718
	2005	112,668	119,846	115,667	119,146	120,921
	2006	113,379	121,644	118,309	120,201	122,397
	Avg.	115,420	120,009	118,000	119,736	121,361
Total Biomass	2001	286,147	286,147	286,147	285,981	285,981
	2002	285,347	287,887	288,616	287,585	291,615
	2003	283,208	290,395	288,946	290,110	294,214
	2004	282,869	293,681	288,339	293,541	296,393
	2005	283,834	297,552	289,110	295,595	298,998
	2006	285,928	301,900	295,321	298,519	302,843
	Avg.	284,556	292,927	289,413	291,889	295,007

Note: Values are in mt. Separate population models exist for the Bering Sea and Aleutian Islands areas

Table 4.2-19 Average age, average F, $F_{40\%}$, and equilibrium catch at $F_{40\%}$ for the Aleutian Islands and eastern Bering Sea portions of the Pacific Ocean Perch under Alternatives 1 through 5.

AI POP					
	Alt1	Alt2	Alt3	Alt4	Alt5
AvgAgeYr2006	9.727	10.089	9.90205	10.116	10.199
AvgF, 01-06	0.066	0.041	0.053	0.047	0.042
F40%	0.073	0.073	0.073	0.073	0.073
Equilibrium catch (F40%)	11.255	11.255	11.255	11.255	11.255
EBS POP					
AvgAgeYr2006	10.145	9.968	10.2692	10.298	10.312
AvgF, 01-06	0.014	0.025	0.007	0.011	0.010
F40%	0.048	0.048	0.048	0.048	0.048
Equilibrium catch (F40%)	2.498	2.498	2.498	2.498	2.498

Table 4.2-20 Projected catch and Acceptable Biological Catch of Bering Sea/Aleutian Islands other red rockfish under Alternatives 1 through 5.

	Year	Alt1	Alt2	Alt3	Alt4	Alt5
Catch	2001	5,672	2,813	5,136	5,657	5,515
	2002	5,735	2,820	5,400	5,645	5,689
	2003	5,440	2,866	5,366	5,569	5,672
	2004	5,443	2,929	5,396	5,639	5,605
	2005	5,579	2,971	4,954	5,630	5,564
	2006	5,509	2,990	4,951	5,565	5,505
	Avg.	5,563	2,898	5,201	5,618	5,592
ABC	2001	6,229	6,617	6,617	6,617	6,617
	2002	6,229	6,617	6,617	6,617	6,617
	2003	6,229	6,617	6,617	6,617	6,617
	2004	6,229	6,617	6,617	6,617	6,617
	2005	6,229	6,617	6,617	6,617	6,617
	2006	6,229	6,617	6,617	6,617	6,617
	Avg.	6229	6617	6617	6617	6617

Note: Values are in mt.

Table 4.2-21 Projected catch and Acceptable Biological Catch of Bering Sea/Aleutian Islands other rockfish under Alternatives 1 through 5.

	Year	Alt1	Alt2	Alt3	Alt4	Alt5
Catch	2001	626	574	689	572	581
	2002	656	575	691	499	536
	2003	598	582	658	492	536
	2004	630	604	705	545	603
	2005	699	629	716	586	673
	2006	724	648	735	610	677
	Avg.	656	602	699	551	601
ABC	2001	1,054	1,792	1,792	1,792	1,792
	2002	1,054	1,792	1,792	1,792	1,792
	2003	1,054	1,792	1,792	1,792	1,792
	2004	1,054	1,792	1,792	1,792	1,792
	2005	1,054	1,792	1,792	1,792	1,792
	2006	1,054	1,792	1,792	1,792	1,792
	Avg.	1,054	1,792	1,792	1,792	1,792

Note: Values are in mt

4.2.5.2.1 Effects of Alternative 1 on Bering Sea/Aleutian Islands Rockfish

Under Alternative 1, the current management regime, the regulatory measures implemented by emergency rule would expire; more information about this Alternative can be found in Section 2.7.4.

Total biomass

The combined total POP biomass decreased from 286,147 mt in 2001 to 285,928 mt in 2006 (Table 4.2-18).

Spawning biomass

The projections indicated that the combined spawning stock biomass for the Bering Sea and Aleutian Islands POP would decrease 7% from 120,091 mt in 2001 to 113,379 mt in 2006 (Table 4.2-18).

Catch

The harvest changed only slightly during the projection period, changing from 10,665 mt in 2001 to 10,038 mt in 2006 (Table 4.2-18).

For BSAI other red rockfish, the projected catch decreased 3% from 5,673 mt in 2001 to 5,509 mt in 2006, whereas the other rockfish projected catch changed from 626 mt to 724 mt over the same period (Tables 4.2-20 and -21).

Status determination

The average fishing mortality rates for both the EBS and AI portion of the POP population are below their $F_{40\%}$ levels (Table 4.2-19).

The average spawning stock biomass for BSAI POP 115,420 mt, above the $B_{35\%}$ value of 106,267 mt.

Spatial temporal concentration

Alternative 1 removes measures designed to disperse the EBS pollock fishery in space and time but retains measures that disperse the spatial and temporal extent of the Atka mackerel fishery. The impact of the removal of the pollock measures is expected to be small due to relatively little POP bycatch in EBS pollock fisheries. The impact of the remaining measures affecting the Atka mackerel fishery may have some beneficial impact to the extent that they minimize POP bycatch.

Size and age composition

The average age in year 2006 is projected as 9.7 yrs and 10.1 yrs for the AI and EBS portions of the stock, respectively (Table 4.2-19).

Conclusion

Overall, the management measures under Alternative 1 would not be expected to have significant effects on BSAI POP sustainability, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability (Table 4.2-22). Based on the projected catch levels, Alternative 1 is not expected to have a significant impact on the sustainability of either other red rockfish or other rockfish (Table 4.2-22).

4.2.5.2.2 Effects of Alternative 2 on Bering Sea/Aleutian Islands Rockfish

Under Alternative 2, lower total allowable catch levels are established for pollock, cod, and mackerel, trawling is prohibited in critical habitat, and catch is more spread out throughout the year.

Total Biomass

The total BSAI POP biomass increases from 286,147 mt in 2001 to 301,900 mt in 2005 (Table 4.2-18).

Spawning biomass

The spawning biomass increases slightly over the projection period, changing from 120,422 mt in 2001 to 121,644 mt in 2005 (Table 4.2-18).

Catch

The projected catch for BSAI POP decreases slightly from 8,165 mt in 2001 to 7,932 mt in 2006; these values are considerably below the equilibrium catch at F_{40} of 13,753 mt and the projected catch levels in Alternative 1. The reduction in POP catch is expected to come as a result of limiting the maximum Atka mackerel TAC to 33% of the maximum ABC, and imposing daily catch limits for the Atka mackerel fleet. The short period of the projections, and low fishing mortality rates, resulted in the decreases in catch being more severe than the changes in biomass.

For BSAI other red rockfish, the average projected catch from 2001-2006 was 2,898 mt, a reduction from the 5,563 mt under Alternative 1 (Tables 4.2-20).

For BSAI other rockfish, the average projected catch from 2001-2006 was 602 mt, a decrease from the value of 656 mt under Alternative 1 (Tables 4.2-21).

Status determination

The average fishing mortality rates for both the EBS and AI portion of the POP population are below their $F_{40\%}$ levels (Table 4.2-19).

The average spawning stock biomass for BSAI POP 120,009 mt, above the $B_{35\%}$ value of 106,267 mt.

Size and age composition

The average age in year 2006 is projected as 10.1 yrs and 10.0 yrs for the AI and EBS portions of the stock, respectively (Table 4.2-19).

Conclusion

Overall, the management measures under Alternative 2 would not be expected to have significant effects on BSAI POP sustainability, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability. Based on the projected catch levels, Alternative 2 is not expected to have a significant impact on the sustainability of either other red rockfish or other rockfish.

4.2.5.2.3 Effects of Alternative 3 on Bering Sea/Aleutian Islands Rockfish

Under Alternative 3, directed fishing for cod, pollock, and Atka mackerel is prohibited in large areas of critical habitat, and catch levels are reduced for these fisheries in the remaining critical habitat areas. This Alternative is the RPA in the NMFS 2000 Biological Opinion.

Total biomass

The total biomass of BSAI POP increased over the same period from 286,147 mt to 295,321 mt (Table 4.2-18).

Spawning biomass

The spawning biomass decreased over the projection period from 120,491 mt in 2001 to 118,309 mt in 2006 (Table 4.2-18).

Catch

The average projected catch for BSAI POP from 2001-2006 was 8,837 mt, compared with a value of 11,055 mt under Alternative 1 (Table 4.2-18).

For BSAI other red rockfish, the average projected catch from 2001-2006 was 5,201 mt, a slight reduction from the 5,563 mt under Alternative 1 (Table 4.2-20). For BSAI other rockfish, the average projected catch from 2001-2006 was 699 mt, an increase from the value of 656 mt under Alternative 1 (Table 4.2-21).

Status determination

The average fishing mortality rates for both the EBS and AI portion of the POP population are below their $F_{40\%}$ levels (Table 4.2-19).

The average spawning stock biomass for BSAI POP 118,000 mt, above the $B_{35\%}$ value of 106,267 mt (Table 4.2-18).

Size and age composition

The average age in year 2006 is projected as 9.9 yrs and 10.3 yrs for the AI and EBS portions of the stock, respectively (Table 4.2-19).

Conclusion

Overall, the management measures under Alternative 3 would not be expected to have significant effects on BSAI POP sustainability, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability. Based on the projected catch levels, Alternative 3 is not expected to have a significant impact on the sustainability of either other red rockfish or other rockfish.

4.2.5.2.4 Effects of Alternative 4 on Bering Sea/Aleutian Islands Rockfish

Alternative 4 consists of fishery-specific closed areas around rookeries and closed areas, together with area- and fishery-specific seasons and catch apportionments.

Catch

The average projected catch for BSAI POP from 2001-2006 was 8,272 mt, compared with a value of 11,055 mt under Alternative 1 (Table 4.2-18).

For BSAI other red rockfish, the average projected catch from 2001-2006 was 5,617 mt, an increase from the 5,563 mt under Alternative 1 (Table 4.2-20).

For BSAI other rockfish, the average projected catch from 2001-2006 was 550 mt, a decrease from the value of 656 mt under Alternative 1 (Table 4.2-21).

Total biomass

Total biomass of BSAI POP increased over the same period from 285,981 mt to 298,519 mt (Table 4.2-18).

Spawning biomass

The spawning biomass remained nearly constant over the projection period, changing from 120,438 mt in 2001 to 120,201 mt in 2006 (Table 4.2-18).

Status determination

The average fishing mortality rates for both the EBS and AI portion of the POP population are above their $F_{40\%}$ levels (Table 4.2-19).

The average spawning stock biomass for BSAI POP 119,736 mt, above the $B_{35\%}$ value of 106,267 mt (Table 4.2-18).

Size and age composition

The average age in year 2006 is projected as 10.1 yrs and 10.3 yrs for the AI and EBS portions of the stock, respectively (Table 4.2-19).

Conclusion

Overall, the management measures under Alternative 4 would not be expected to have significant effects on BSAI POP sustainability, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability. Based on the projected catch levels, Alternative 4 is not expected to have a significant impact on the sustainability of either other red rockfish or other rockfish.

4.2.5.2.5 Effects of Alternative 5 on Bering Sea/Aleutian Islands Rockfish

Alternative 5 consists of the suite of RPA measures in place for the 2000 pollock and Atka mackerel fisheries, and seasonal apportionments and harvest limits for the Pacific cod fishery within critical habitat areas.

Total biomass

Total biomass of BSAI POP increased over the same period from 285,981 mt to 302,843 mt (Table 4.2-18).

Spawning biomass

The spawning biomass increased slightly over the projection period from 120,934 mt in 2001 to 122,397 mt in 2006 (Table 4.2-18).

Catch

The average projected catch for BSAI POP from 2001-2006 was 7,397 mt, compared with a value of 11,055 mt under Alternative 1 (Table 4.2-18). Catch increases markedly from 3,956 mt in 2001 to 7,259 mt in 2006.

For BSAI other red rockfish, the average projected catch from 2001-2006 was 5,592 mt, nearly identical to the 5,563 mt under Alternative 1 (Table 4.2-20).

For BSAI other rockfish, the average projected catch from 2001-2006 was 601 mt, a decrease from the value of 656 mt under Alternative 1 (Table 4.2-21).

Status determination

The average fishing mortality rates for both the EBS and AI portion of the POP population are above their $F_{40\%}$ levels (Table 4.2-19).

The average spawning stock biomass for BSAI POP 121,361 mt, above the $B_{35\%}$ value of 106,267 mt (Table 4.2-18).

Size and age compositions

The average age in year 2006 is projected as 10.2 yrs and 10.3 yrs for the AI and EBS portions of the stock, respectively (Table 4.2-19).

Conclusion

Overall, the management measures under Alternative 5 would not be expected to have significant effects on BSAI rockfish sustainability, either through direct effects of fishing mortality or concentration of the catch, or indirect effects of change in prey availability and habitat suitability. Based on the projected catch levels, Alternative 5 is not expected to have a significant impact on the sustainability of either other red rockfish or other rockfish.

4.2.5.2.6 Summary of Effects on Bering Sea/Aleutian Islands Rockfish

The criteria used to estimate the significance of two direct and two indirect impacts of Alternatives 1 through 5 on the BSAI stocks of rockfish are outlined in Table 4.2-3. Tables 4.2-22 and -23 summarize the effects of Alternatives 1 through 5 on rockfish in the BSAI.

Under each of the Alternatives, the average projected fishing mortality from 2001 to 2006 was below the F_{OFL} for both the Aleutian Islands and eastern Bering Sea POP. Thus, under the criteria in Table 4.2-3, the effect of the Alternatives on fishing mortality is insignificant. Additionally, the average projected spawning stock biomass from 2001 to 2006 is greater than the $B_{35\%}$ (B_{msy}) level of 106,267 mt; thus the BSAI POP is projected to remain above the MSST. For this reason, any change in the spatial and temporal concentration of the POP catch is not expected to affect the ability of the stock to sustain itself. Similarly, knowledge of the indirect effects of prey availability and habitat suitability is limited, but it is expected that the alternatives would not affect these factors such that POP sustainability is compromised. Minimum spawning size threshold is not known for BSAI other red rockfish, or other rockfish, so evaluations of significance of the Alternatives are based only upon projected harvest levels. The projected harvests of other red rockfish or other rockfish do not exceed the ABC levels under any of the Alternatives; thus, the effect of the Alternatives on fishing mortality is considered insignificant under the guidelines in Table 4.2-3.

Table 4.2-22 Summary of effects of Alternatives 1 through 5 on BSAI Pacific Ocean perch.

BSAI POP	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.2-23 Summary of effects of Alternatives 1 through 5 on other red and other rockfish target species in the BSAI.

Species/Species Group	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
BSAI other red rockfish and other rockfish					
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	U	U	U	U	U
Indirect Effects					
Change in prey availability	U	U	U	U	U
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.2.5.3 Gulf of Alaska Rockfish

4.2.5.3.1 Effects of Alternatives 1 through 5 on Gulf of Alaska Rockfish

There would appear to be relatively little direct effect of the alternatives upon adult rockfish in the GOA or their fishery. The various GOA alternatives consist mostly of no-fishing or no-trawling zones within 20 nm or less of sea lion rookeries or haulouts, and/or fishery closures for walleye pollock or Pacific cod, which are known to be prey items for sea lions. The major species of rockfish in the central and western GOA (Pacific ocean perch, northern rockfish, light dusky rockfish, and shortraker/rougheye rockfish) all reside as adults in waters of the outer continental shelf or continental slope, and this is where commercial fishing for these species is located. Pacific ocean perch is the only species for which MSST is known. In general, the fishing grounds for GOA rockfish are considerably offshore and outside of the proposed no-fishing areas in the alternatives. This is especially true for the central GOA (areas 620 and 630), which has a very broad continental shelf, where most of the biomass for these rockfish species is found and where most of the fishery occurs. Consequently, the area closures in the alternatives would probably have little impact in this area on rockfish fishing mortality or spatial/temporal distribution of the catch. The area closures might have a somewhat greater effect in the western GOA (area 610), where the continental shelf is narrower, and some of closed areas appear to overlap locations where rockfish have been taken in the commercial fishery. If the area/trawl closures went into effect, some fishing effort in the western GOA would likely be displaced to localities farther offshore outside the closed areas. The fishing closures in the alternatives for walleye pollock and Pacific cod in the GOA would probably have little direct effect on rockfish. Walleye pollock and Pacific cod are both usually found in shallower, more inshore waters than are adult rockfish, and by-catch of rockfish in targeted fisheries for walleye pollock and Pacific cod in the GOA is very low.

Indirect effects of the alternatives, however, are less certain, especially concerning the trophic interactions of rockfish. Adult walleye pollock, Pacific Ocean perch, northern rockfish, and light dusky rockfish all consume euphausiids as their major prey item (Yang 1993), so there appears to be considerable overlap in the diets of these species. Any of the alternatives that reduce the commercial catch of walleye pollock would cause abundance of these fish to increase. Consequently, more euphausiids would be consumed by walleye pollock, which could mean that less would be available for rockfish to eat. How much less is unknown, as there is little or no quantitative information on trophic interactions between rockfish and walleye pollock or information on whether they even feed on the same spatial aggregations of euphausiids. In contrast to walleye pollock, there appears to be little overlap in the diet of Pacific cod with most rockfish species, so that reduction in Pacific cod catches as a result of the alternatives would likely have little impact upon rockfish in terms of trophic interactions. Food studies for Pacific cod also show that although this fish is a major predator for many fish species in the GOA, rockfish are consumed very infrequently (Yang 1993; Yang and Nelson 2000).

To an unknown degree, the area/trawl closures may have some habitat benefits to juvenile rockfish. Although information on juvenile rockfish distribution is generally quite limited, juveniles for most species are thought to inhabit shallower, more inshore areas than do adults. Some may be associated with epifauna that provide structural relief on the bottom such as corals or sponges. All the alternatives proposed in this SEIS could serve to protect this type of habitat because they prevent fishing activities, such as trawling, that may be harmful to corals or sponges. However, it is not possible to conclusively say that any of the alternatives will have significant habitat benefits for juvenile rockfish, because so little research has been done on the distribution and habitat requirements of these fish or on how much damage to benthic habitat occurs as result of fishing gear.

4.2.5.3.2 Summary of Effects on Gulf of Alaska Rockfish

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the GOA stocks of rockfish are outlined in Table 4.2-3. Table 4.2-24 summarize the effects of Alternatives 1 through 5 on rockfish in the GOA.

Table 4.2-24 Summary of effects of Alternatives 1 through 5 on Gulf of Alaska rockfish.

GOA Rockfish	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	U	U	U	U	U
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	U	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.2.5.4 Effects on Gulf of Alaska Thornyheads

Thornyheads are primarily caught as bycatch in longline fisheries directed at sablefish and in trawl fisheries targeting deepwater flatfish and rockfish in the Gulf of Alaska (GOA). None of the alternatives proposed for Stellar sea lion protection directly affect the fisheries where shortspine thornyheads are caught. Therefore, it should come as no surprise that there is little contrast between alternatives with respect to predicted impacts on shortspine thornyheads, and that none of the alternatives are expected to have significant impacts on thornyhead stocks, prey, or habitat.

Projected average thornyhead yield (2001-2006) for the alternatives ranges from 1,192 mt to 1,504 mt in the GOA (Table 4.2-25). Alternative 3 is projected to provide the lowest average yield. The other alternatives are projected to provide higher average yields of similar magnitude. Alternative 5 is projected to provide the highest average yield. These differences in yield between alternatives are small enough that differences in spawning biomass between alternatives are very minor (and probably indistinguishable considering the variance inherent in estimating spawning biomass). In all cases, the spawning biomass levels are predicted to be maintained well above the $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt). Fishing mortality rates are projected to be well below the F_{OFL} (and even below F_{ABC}) under all alternatives in all years. Projected average total biomass ranges from 53,161 mt to 53,863 mt for the GOA. The projected difference in the average age of the population between alternatives is approximately one month, which we consider to be insignificant in a species that lives 50 to 100 years or more. We summarize the effects of each alternative below, where we focus on impacts under Alternative 1 and then point out any contrasts under the other alternatives, since the predicted impacts under each alternative are similar to those under Alternative 1 (insignificant).

Table 4.2-25 Gulf of Alaska thornyheads. Five year population model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under each alternative, in units of thousands of metric tons

	Year	Alt1	Alt2	Alt3	Alt4	Alt5
Catch (1000 t)	2001	1.266	1.354	1.197	1.463	1.471
	2002	1.245	1.331	1.234	1.475	1.483
	2003	1.251	1.433	1.252	1.526	1.528
	2004	1.215	1.470	1.223	1.535	1.538
	2005	1.189	1.432	1.155	1.541	1.544
	2006	1.172	1.437	1.092	1.416	1.462
	Avg.	1.223	1.409	1.192	1.493	1.504
ABC (1000 t)	2001	2.364	2.364	2.364	2.364	2.364
	2002	2.396	2.391	2.400	2.385	2.385
	2003	2.432	2.422	2.437	2.408	2.407
	2004	2.469	2.448	2.473	2.429	2.428
	2005	2.504	2.469	2.508	2.445	2.444
	2006	2.534	2.485	2.540	2.455	2.453
	Avg.	2.450	2.430	2.454	2.414	2.414
Spawning Biomass (1000 t)	2001	23.19	23.19	23.19	23.19	23.19
	2002	23.28	23.23	23.31	23.18	23.18
	2003	23.37	23.28	23.41	23.16	23.15
	2004	23.45	23.27	23.49	23.10	23.09
	2005	23.55	23.25	23.59	23.05	23.04
	2006	23.67	23.24	23.72	22.99	22.98
	Avg.	23.42	23.24	23.45	23.11	23.10
Fishing Mortality	2001	0.027	0.028	0.025	0.031	0.031
	2002	0.026	0.028	0.025	0.031	0.031
	2003	0.025	0.029	0.025	0.031	0.032
	2004	0.024	0.030	0.024	0.031	0.031
	2005	0.023	0.029	0.023	0.031	0.031
	2006	0.023	0.029	0.021	0.029	0.030
	Avg.	0.025	0.029	0.024	0.031	0.031
Total Biomass (1000 t)	2001	53.33	53.33	53.33	53.33	53.33
	2002	53.48	53.39	53.55	53.29	53.28
	2003	53.66	53.48	53.74	53.24	53.22
	2004	53.86	53.49	53.94	53.15	53.13
	2005	54.09	53.47	54.16	53.07	53.05
	2006	54.36	53.49	54.46	52.99	52.96
	Avg.	53.80	53.44	53.86	53.18	53.16
Avg. Age in 2006		9.778	9.693	9.791	9.648	9.643

Note: Average age in 2006 is also given for each alternative

4.2.5.4.1 Effects of Alternative 1 on Gulf of Alaska Thornyheads

Under the current management regime - Alternative 1, which is described in the preceding section, the general impacts of fishing mortality within Amendment 56/56 ABC/OFL definitions are discussed in Section 2.7.4 of the programmatic EIS, and apply to shortspine thornyheads in the Gulf of Alaska.

GOA thornyheads fall within Tier 3a of the ABC/OFL definitions, meaning that data are insufficient to estimate MSY, so a proxy SPR rate of F35% is used to determine OFL, and F40% is the basis of ABC. Projections of spawning biomass, total biomass, and expected catch were made through 2006 to examine the short-term impact of each alternative on thornyheads. The projections start with the vector of 2001 numbers at age estimated in the most recent assessment (Ianelli and Gaichas 1999). Spawning biomass is computed in each year based on the time of peak spawning (April) and the maturity and weight schedules described in the assessment. Catch is generally lower than the projected ABC for GOA thornyheads, primarily because this is a bycatch fishery.

Total biomass

Average total biomass is projected to remain stable or slightly increase from 53.3 thousand mt in 2001 to 54.4 thousand mt in 2006 (Table 4.2-25).

Spawning biomass

The projections for the GOA thornyhead stock under status quo management indicate that spawning biomass is expected to increase slightly between 2001 and 2006, by approximately 2% (Table 4.2-25).

Status determination

The GOA thornyhead stock is not overfished. At 23,190 mt, spawning stock biomass is expected to be well above both $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt) in the year 2001 and will remain above $B_{40\%}$ in all projection years.

The average fishing mortality rate for thornyheads was 0.025 which is well below the F_{OFL} level so overfishing is not likely to occur.

Catch

The average expected yield for the period 2001 - 2006 was 1,223 mt (Table 4.2-25).

Size and age composition

The average of the population under Alternative 1 is 9.7 years (Table 4.2-25).

Sex ratio

A 50:50 sex ratio is assumed for the GOA thornyhead assessment and projections. Trawl survey estimates of the population sex ratio indicate values of 52:48 (M:F) for all survey years combined, and 54:46 for the 1999 trawl survey. These numbers do not include thornyheads encountered which were too small to be sexed reliably (between 5-20% of catch), so deviations from the 50:50 ratio are not considered significant. Based upon observations of the stock to date, no changes are expected to the population sex ratio under status quo management or under any of the proposed changes. However, it cannot be predicted that changes will not happen in the future due to unforeseen circumstances.

Spatial temporal concentration and habitat mediated impacts

Thornyhead catch is approximately evenly divided between longliners and trawlers under status quo management. Longline catches are spatially dispersed along the continental shelf break throughout the Gulf of Alaska (Ianelli and Gaichas 1999, Figure 9.2), and temporally dispersed due to the nature of the IFQ sablefish fishery. For example, longline thornyhead catches in 2000 occurred year round, with peaks in April and September which did not exceed 60 mt per week. Trawler catch has been more concentrated in time, with some catches of 20-40 mt per week happening in late spring and a single large peak of 160 mt per week in 2000 during July, coincident with the rockfish trawl fishery. Between 1997 and 1999, trawl thornyhead catches appear to have become more concentrated in space (Ianelli and Gaichas 1999, Figure 9.3). The distribution of thornyheads from surveys did not appear to change over the same time period (Ianelli and Gaichas 1999, Figure 9.5). This apparent concentration may be the indirect result of changes in the trawl fisheries for deepwater flatfish and rockfish since thornyheads are not a primary target of trawl fisheries. However, it should be noted that the overall catch of thornyheads is low relative to both the estimated biomass and the ABC, such that this apparent concentration of catch is unlikely to have any negative population effects.

Under Alternative 1, management measures designed to disperse the catch of pollock, Pacific cod and Atka mackerel spatially (closed areas) and temporally (seasonal partitions) would be removed. Because these three fisheries have negligible thornyhead bycatch and the affected areas are nearshore where thornyheads are not found, these changes are not expected to have any significant effects on the spatial and temporal concentration of thornyhead catch in the Gulf of Alaska. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 1 does not appear to affect the sustainability of thornyheads either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated impacts

In the Gulf of Alaska, shortspine thornyheads prey on benthic invertebrates; according to the AFSC food habits database, much of their diet in the 1990's has been composed of shrimp. Thornyheads are rare in the diets of other groundfish, birds, or marine mammals in the Gulf of Alaska according to the present limited information. Therefore, the effects of status quo federal groundfish fisheries on trophic interactions involving GOA thornyheads are expected to be minor. The current levels and distribution of groundfish harvest do not appear to impact prey availability for thornyheads such that it affects the sustainability of the stock as measured by the ability of the stock to maintain itself above its MSST.

4.2.5.4.2 Effects of Alternative 2 on Gulf of Alaska Thornyheads

The slow and low approach calls for several significant management changes to pollock, Pacific cod, and Atka mackerel fisheries. Because these fisheries catch negligible amounts of shortspine thornyheads, these changes are not expected to impact thornyheads. The only change which applies to all fisheries and is unique to this alternative is that groundfish trawling would be prohibited within Steller sea lion critical habitat. In the Gulf of Alaska, critical habitat extends to very few deepwater areas inhabited by thornyheads, so even this restriction is not expected to have significant impacts in terms of spatial concentration of thornyhead catch.

Catch

Under this alternative, catches of thornyheads are predicted to increase slightly relative to Alternative 1 to an average of 1.4 thousand mt annually (this is due to increased catches of sablefish and rockfish species under this alternative; the thornyhead catch scales accordingly).

Spawning biomass

The spawning stock biomass is expected to be about 23 thousand mt between 2001-2006 (Table 4.2-25).

Status determination

The spawning stock biomass is expected to remain well above the $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt) (Table 4.2-25). The fishing mortality level is set below $F_{0.1}$ so overfishing is not likely to occur.

Size and age composition

Alternative 2 is not predicted have an impact on the size and age compositions of the GOA thornyhead population as catches are very similar to status quo (Table 4.2-25).

Sex ratio

Deviations from the assumed 50:50 sex ratio are not expected under alternative 2, but what changes, if any, might occur in the future are unknown.

Spatial temporal concentration and habitat mediated impacts

Under Alternative 2 temporal and spatial aggregation of groundfish fishing would be reduced, although alterations to fisheries which catch thornyheads are limited. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 2 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated impacts

Lower catches of Atka mackerel, pollock and Pacific cod under Alternative 2 might change some trophic dynamics within the GOA ecosystem, but the impacts on shortspine thornyheads are not expected to be significant. None of these species prey on thornyheads, and none directly compete with thornyheads for prey resources because they generally occupy different habitats (thornyheads are found in deeper waters). While it cannot rule out more subtle trophic or habitat effects on shortspine thornyheads under Alternative 2, it cannot be predicted what these effects may be with the current limited knowledge of the system. Based on current knowledge, any impacts under Alternative 2 are unlikely to result in a change in prey availability such that it jeopardizes the ability of the GOA thornyhead stock to sustain itself above the MSST.

4.2.5.4.3 Effects of Alternative 3 on Gulf of Alaska Thornyheads

The restricted and closed area approach calls for several management changes to pollock, Pacific cod, and Atka mackerel fisheries. Because these fisheries catch negligible amounts of shortspine thornyheads, these changes are not expected to impact thornyheads.

Catch

Under Alternative 3, catches of thornyheads are almost indistinguishable from those predicted under Alternative 1, averaging 1.19 thousand mt annually (Table 4.2-25).

Spawning biomass

Spawning stock biomass is predicted to remain stable or increase slightly as under Alternative 1 between 2001-2006 (Table 4.2-25).

Status determination

The spawning biomass is expected to remain well above the $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt) (Table 4.2-25). The fishing mortality level is set below $F_{0.1}$ so overfishing is not likely to occur.

Size and age compositions

Alternative 3 is not likely to have an impact on the size and age composition of GOA thornyheads as catches do not change significantly relative to those predicted under Alternative 1. Deviations from the assumed 50:50 sex ratio are not expected under Alternative 3, but what changes, if any, might occur in the future are unknown.

Spatial temporal concentration and habitat mediated impacts

Under Alternative 3 temporal and spatial aggregation of groundfish fishing would be reduced, although alterations to fisheries which catch thornyheads are limited. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 3 does not appear to affect the sustainability of the stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated impacts

Catches of Atka mackerel, pollock and Pacific cod under Alternative 3 are only slightly lower than those predicted under Alternative 1, so there are few changes predicted to the trophic dynamics within the GOA ecosystem. Therefore, the impacts on shortspine thornyheads due to trophic effects under Alternative 3 are not expected to be significant. Based on current knowledge, any impacts under Alternative 3 are unlikely to result in a change in prey availability such that it jeopardizes the ability of the GOA thornyhead stock to sustain itself above the MSST.

4.2.5.4.4 Effects of Alternative 4 on Gulf of Alaska Thornyheads

The area and fishery specific approach calls for several detailed management changes to pollock, Pacific cod, and Atka mackerel fisheries. Because these fisheries catch negligible amounts of shortspine thornyheads, these changes are not expected to impact thornyheads. The only change which applies to all fisheries and is unique to this alternative is that groundfish fishing would be prohibited within 20 nm of the 5 northern Steller sea lion haulouts in the Bering Sea. This restriction has no impact whatsoever on GOA thornyheads.

Catch

Under alternative 4, catches of thornyheads are predicted to increase slightly relative to those predicted under Alternative 1, averaging 1.49 thousand mt annually (Table 4.2-25). The increased catch appears to result from increases in deepwater flatfish and sablefish catches under Alternative 4.

Spawning biomass

Spawning stock biomass of thornyheads is predicted to remain stable at 22 to 23 thousand mt between 2001-2006 (Table 4.2-25).

Status determination

The spawning stock biomass is expected to remain well above the $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt). The fishing mortality level is set below $F_{0.1}$ so overfishing is not likely to occur.

Size and age composition

Alternative 4 is not likely to have an impact on the size and age composition of GOA thornyheads as catches only slightly increase relative to those predicted under Alternative 1.

Sex ratio

Deviations from the assumed 50:50 sex ratio are not expected under alternative 4, but what changes, if any, might occur in the future are unknown.

Spatial temporal concentration and habitat mediated impacts

Under Alternative 4 temporal and spatial aggregation of groundfish fishing would be reduced, although alterations to fisheries which catch thornyheads are limited. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 4 does not appear to affect the sustainability of the thornyhead stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated impacts

Catches of Atka mackerel, pollock and Pacific cod under alternative 4 are no lower than those predicted under Alternative 1, so there are few changes predicted to the trophic dynamics within the GOA ecosystem. Therefore, the impacts on shortspine thornyheads due to trophic effects under Alternative 4 are not expected to be significant, for the same reasons discussed under previous alternatives. Based on current knowledge,

any impacts under Alternative 4 are unlikely to result in a change in prey availability such that it jeopardizes the ability of the GOA thornyhead stock to sustain itself above the MSST.

4.2.5.4.5 Effects of Alternative 5 on Gulf of Alaska Thornyheads

The critical habitat catch limit approach calls for several management changes to pollock, Pacific cod, and Atka mackerel fisheries. Because these fisheries catch negligible amounts of shortspine thornyheads, these changes are not expected to impact thornyheads. The only change which applies to all fisheries and is unique to this alternative is that groundfish fishing would be prohibited within 10 or 20 nm of 37 Steller sea lion rookeries in the Bering Sea, Aleutian Islands and Gulf of Alaska. This restriction is not expected to have any impacts on GOA thornyheads.

Catch

Under Alternative 5, catches of thornyheads are predicted to increase slightly relative to those predicted under Alternative 1, averaging 1.5 thousand mt annually. The increased catch appears to result from increases in deepwater flatfish and sablefish catches under Alternative 5.

Spawning biomass

Spawning stock biomass of thornyheads is predicted to remain stable at 22 to 23 thousand mt between 2001-2006 (Table 4.2-25)

Status determination

Spawning biomass is expected to remain well above the $B_{35\%}$ level (15,342 mt) as well as the $B_{40\%}$ level (17,533 mt). The fishing mortality level is set below $F_{0.1}$ so overfishing is not likely to occur.

Size and age composition

Alternative 5 is not likely to have an impact on the size and age composition of GOA thornyheads as catches only slightly increase relative to those predicted under Alternative 1.

Sex ratio

Deviations from the assumed 50:50 sex ratio are not expected under Alternative 5, but what changes, if any, might occur in the future are unknown.

Spatial temporal concentration and habitat mediated impacts

Under Alternative 5 temporal and spatial aggregation of groundfish fishing would be reduced, although alterations to fisheries which catch thornyheads are limited. The level of habitat disturbance and the temporal/spatial concentration of the catch under Alternative 5 does not appear to affect the sustainability of the thornyhead stock either through changes in the genetic structure of the population or changes in reproductive success, as measured by the ability of the stock to maintain itself above its MSST.

Predation mediated impacts

Catches of Atka mackerel, pollock and Pacific cod under Alternative 5 are no lower than those predicted under Alternative 1, so there are few changes predicted to the trophic dynamics within the GOA ecosystem. Therefore, the impacts on shortspine thornyheads due to trophic effects under Alternative 4 are not expected to be significant, for the same reasons discussed under previous alternatives. Based on current knowledge, any impacts under Alternative 5 are unlikely to result in a change in prey availability such that it jeopardizes the ability of the GOA thornyhead stock to sustain itself above the MSST.

4.2.5.3.6 Summary of Effects on Thornyheads

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the GOA stock of thornyheads are outlined in Table 4.2-3. Table 4.2-26 summarizes the effects of Alternatives 1 through 5 on thornyheads in the GOA. The ratings utilize the MSST as a basis for positive or negative impacts of each alternative. A thorough description of the rationale for the MSST can be found in the National Standard Guidelines 50 CFR Part 600 (Federal Register Vol. 63, No. 84, 24212 - 24237). Under Alternatives 1 - 5, the spawning stock biomass of GOA thornyheads is expected to be above the MSST. None of the alternatives would allow fishing mortality to exceed the overfishing level therefore the fishing mortality impacts are rated as insignificant. The GOA thornyhead stock is currently above its MSST and the expected changes in spatial temporal concentration, habitat or predation mediated impacts under each alternative are not substantial enough to expect that the genetic diversity or reproductive success of these stocks would change under the alternative management regime.

Table 4.2-26 Summary of effects of Alternatives 1 through 5 on GOA thornyheads.

GOA Thornyheads	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Direct Effects					
Fishing mortality	I	I	I	I	I
Spatial temporal concentration of catch	I	I	I	I	I
Indirect Effects					
Change in prey availability	I	I	I	I	I
Habitat suitability: change in suitability of spawning, nursery, or settlement habitat, etc.	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.2.5.5 Sablefish

The projected impact on average sablefish yield differs between alternatives in the Bering Sea and Aleutian Islands, but not the Gulf of Alaska (Table 4.2-27). Projected average pollock yield (2002-2006) for the alternatives ranges from 1.3 - 4.5 thousand mt in the BS/AI, with Alternative 2 projected to provide the lower average yield. As expected, the highest level of spawning biomass is projected for the Alternative with the lowest average yield, Alternative 2. In all cases, the spawning biomass levels were maintained above $B_{35\%}$. Also as expected, average age is projected to be higher for Alternative 2. Average yield is lower for Alternative 2 in the BS/AI, but not the GOA because of the spatial distribution of the catch. Much of the sablefish catch in the BS/AI has been caught in Steller sea lion critical habitat (74% in 1999), but only a small part in the GOA (5% in 1999). Biological reference points ($B_{35\%}$, $B_{40\%}$, $F_{40\%}$) and estimated average age of the population under different fishing mortality rates are presented in Table 4.2-28.

Table 4.2-27 Gulf of Alaska, Bering Sea, and Aleutian Island sablefish. Five-year populations model projections of average catch, ABC (Acceptable Biological Catch), average spawning biomass, and total biomass under Alternatives 1 through 5

	Bering Sea / Aleutian Islands						Gulf of Alaska				
	Alt1	Alt2	Alt3	Alt4	Alt5		Alt1	Alt2	Alt3	Alt4	Alt5
Catch (1000 t)	2001	4.1	1.6	4.1	4.1	4.1	16.7	16.7	16.7	16.7	16.7
	2002	4.1	1.6	4.1	4.1	4.1	17.0	17.0	17.0	17.0	17.0
	2003	4.4	1.6	4.4	4.4	4.4	18.2	18.4	18.4	18.5	18.5
	2004	4.5	1.6	4.5	4.5	4.4	18.3	18.8	18.8	19.2	19.2
	2005	4.6	1.6	4.6	4.4	4.4	18.2	18.7	18.6	19.5	19.5
	2006	4.9	1.6	4.9	4.6	4.6	18.9	19.5	19.3	20.9	20.8
	Avg.	4.5	1.6	4.5	4.4	4.4	18.1	18.5	18.4	19.0	19.0
ABC (1000 t)	2001	4.1	4.1	4.1	4.1	4.1	16.7	16.7	16.7	16.7	16.7
	2002	4.1	4.5	4.1	4.1	4.1	17.0	17.0	17.0	17.0	17.0
	2003	4.4	5.3	4.4	4.4	4.4	18.5	18.5	18.5	18.5	18.5
	2004	4.5	5.7	4.5	4.5	4.5	19.0	18.9	18.9	19.2	19.2
	2005	4.6	6.0	4.6	4.4	4.5	19.1	19.0	19.0	19.5	19.5
	2006	4.9	6.4	4.9	4.6	4.6	20.1	20.0	20.0	20.9	20.9
	Avg.	4.5	5.6	4.5	4.4	4.4	18.7	18.7	18.7	19.0	19.0
Spawning Biomass (1000 t)	2001	21.2	21.2	21.2	21.2	21.2	89.3	89.3	89.3	89.3	89.3
	2002	21.2	22.2	21.2	21.2	21.2	89.8	89.8	89.8	89.8	89.8
	2003	21.7	23.9	21.7	21.7	21.7	92.7	92.7	92.7	92.8	92.8
	2004	22.2	25.5	22.2	22.1	22.1	94.9	94.8	94.8	95.1	95.1
	2005	22.2	26.6	22.2	22.1	22.1	95.3	95.0	95.0	95.6	95.6
	2006	22.9	28.5	22.9	22.7	22.7	98.7	98.2	98.2	98.8	98.8
	Avg.	22.0	25.3	22.0	21.9	21.9	94.3	94.1	94.1	94.4	94.4
Fishing Mortality	2001	0.107	0.042	0.107	0.107	0.107	0.103	0.103	0.103	0.103	0.103
	2002	0.106	0.040	0.106	0.106	0.106	0.103	0.104	0.104	0.104	0.104
	2003	0.110	0.036	0.110	0.109	0.109	0.105	0.107	0.107	0.107	0.107
	2004	0.112	0.034	0.112	0.110	0.110	0.105	0.108	0.108	0.110	0.110
	2005	0.112	0.033	0.112	0.107	0.107	0.102	0.105	0.105	0.111	0.111
	2006	0.116	0.031	0.116	0.108	0.108	0.102	0.106	0.105	0.114	0.114
	Avg.	0.111	0.035	0.111	0.108	0.108	0.104	0.106	0.106	0.109	0.109
Total Biomass (1000 t)	2001	65	65	65	65	65	277	277	277	277	277
	2002	66	68	66	65	65	280	280	280	282	282
	2003	68	73	68	67	67	289	289	289	292	292
	2004	69	77	69	69	69	297	297	297	299	299
	2005	70	80	70	70	70	303	302	302	304	304
	2006	72	84	72	71	71	311	309	309	311	311
	Avg.	69	76	69	69	69	296	295	295	298	298
B35	21.4	21.4	21.4	21.4	21.4	93.1	93.1	93.1	93.1	93.1	
B40	24.4	24.4	24.4	24.4	24.4	106	106	106	106	106	
F40	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	0.124	
EquilAvg											
AgeF0	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	
EquilAvgAg											
eF40	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	
AvgAgeYr											
2006	5.7	6.4	5.7	6.0	6.0	6.0	6.0	6.0	6.0	5.7	5.7

Note: Catch, ABC, and biomass estimates are in thousands of mt

4.2.5.5.1 Effects of Alternatives 1 through 5 on Sablefish

The sablefish stock is not overfished. Spawning biomass in 2006 is greater than $B_{35\%}$ for all alternatives (Table 4.2-27).

Fishing mortality is reasonably expected to not jeopardize the capacity of the stock to produce MSY on a continuing basis (Table 4.2-27). The average fishing mortality rate for the sablefish is below the F_{on} for all alternatives in the BS/AI and the GOA.

The evidence is that the distribution of the harvest is not sufficient to alter the genetic sub-population structure or change the reproductive success such that it jeopardizes the ability of the stock to sustain itself at or above the MSST for any alternative. Lower overall catches and the displacement of sablefish catch from the closed areas would impact the directed fishery for sablefish. Fishing effort would be zero in the closed areas, and would likely be reduced in some of the other open fishery locations. This would lower the local fishing mortality rates on sablefish and afford local areas more protection against overfishing or localized depletion. However, effort also would increase in some areas or times as a result of area closures and compress the fishery at certain fishing locations. This would increase the fishing mortality rates on sablefish in these local areas. However sablefish may be less susceptible to the impacts of changes in local fishing mortality rates because they are highly mobile (Heifetz and Fujioka 1991, Kimura et al. 1998).

The evidence is that current harvest levels and distribution of harvest do not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself at or above the MSST for any alternative. Projected sablefish catch decreased under Alternative 2 in the BS/AI, which slightly increases the amounts of sablefish biomass available to the ecosystem. Lower catches of the predators of sablefish could increase the predation on sablefish. It appears that sablefish are opportunistic feeders. Feeding studies conducted in Oregon and California, found that fish made up 76% of the diet (Laidig et al. 1997). Other studies, however, have found a diet dominated by euphausiids (Tanasichuk 1997).

The evidence is that the current levels of habitat disturbance are not sufficient a change to spawning or rearing success such that it jeopardizes the ability of the stock to sustain itself at or above the MSST for any alternative. Sablefish currently are above MSST and have been fished for several decades. However the closure areas in Alternative 2 include areas inhabited by sablefish, both juvenile habitat on the continental shelf and adult habitat on the upper continental slope. The closed areas may reduce any effects fishing may have on sablefish habitat.

4.2.5.5.2 Summary of Effects on Sablefish

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the GOA stock of thornyheads are outlined in Table 4.2-3. Table 4.2-28 summarize the effects of Alternatives 1 through 5 on sablefish in the BSAI and GOA.

sculpin bycatch due to decreases in Pacific cod catch under the alternatives may be compensated by increased flatfish target catches, with increased sculpin bycatch. The increases in flatfish fishing may result from increased allocations of halibut bycatch to these fisheries, which would allow these fisheries to continue longer than under present management. However, actual sculpin bycatch under any of the proposed alternatives is difficult to predict with any precision, for all of the reasons discussed above regarding skate bycatch. It is expected that sculpin bycatch would remain at similar levels to those observed now, because overall fishing remains at similar to current levels under all proposed alternatives. Because the current species and size composition of sculpin bycatch is unknown, it cannot be determined how the species or size composition of sculpin bycatch might change under any alternative, although such changes are likely given the redistribution of fishing effort in space and time. While reasonably good biomass estimates for some Bering Sea sculpin species are available, the effects of any of the proposed management measures on sculpin populations cannot be determined because they are not identified to species in the catch. Consequently, it cannot be determined what effects any changes in bycatch would have on sculpin populations in the BSAI.

Sharks are rarely caught in BSAI fisheries; average catch between 1997-99 was less than 500 mt. Shark bycatch is most commonly recorded in longline fisheries targeting sablefish, turbot, and Pacific cod, and in pelagic trawl fisheries for pollock. The diversity of fisheries reflects the fact that several shark species are being encountered: most often sleeper sharks in longline fisheries and salmon sharks in pollock trawl fisheries. As with sculpins, changes to the pollock and cod fisheries may change shark bycatch, but there may be compensatory changes in other fisheries that also catch sharks. Reductions in pollock fishing may reduce salmon shark bycatch, although it is already very low in the BSAI, so that no real differences would be seen between alternatives. Since sablefish and Pacific cod catches are lower under Alternatives 2 and 3 than other alternatives, it is possible that sleeper shark bycatch might also be lower under these alternatives. However, turbot catches remain similar to present levels under Alternative 2, so there may be less change here. All of the discussion above regarding estimation and prediction of skate and sculpin bycatch also applies to sharks. It is possible that reallocating the catch of Pacific cod and pollock into different areas and seasons would result in displacement of fisheries into areas of higher or lower historical shark bycatch rates. Therefore, actual shark bycatch under any of the proposed alternatives is difficult to predict with any precision. There is no reliable estimate of shark biomass in the Bering Sea, so although most sharks are identified to species in the catch, it cannot be determined what effects any changes in bycatch would have on shark populations in the BSAI.

Octopus bycatch is lowest among all other species in the BSAI, estimated at about 250 mt on average in recent years. However, estimates of octopus catch are highly variable from year to year. Most octopus bycatch comes from pot fisheries targeting Pacific cod, so changes to these fisheries under the proposed alternatives for Steller sea lion protection may change octopus bycatch. Alternatives 2 and 3 appear to restrict pot fishing for Pacific cod within critical habitat more so than the other alternatives, so that octopus bycatch may be somewhat lower under these alternatives. Conversely, if more Pacific cod TAC is allocated to pot gear under a given alternative, octopus bycatch may increase. These projections are based on overall average bycatch rates recently observed in Pacific cod pot fisheries; however, octopus bycatch is difficult to estimate because pot fisheries have only 30% observer coverage required under the best of circumstances. Therefore, actual octopus bycatch under any of the proposed alternatives is difficult to predict with any precision. Furthermore, because there is no reliable biomass estimate for octopus species in the Bering Sea, it cannot be determined whether these changes would have any effects at all on octopus populations.

4.2.5.6.1.2 Summary of Effects on BSAI Squid and Other Species

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the BSAI stocks of squid and other species are outlined in Table 4.2-3. Table 4.2-29 summarizes the effects of Alternatives 1 through 5 on squid and other species stocks and incidental catch in the BSAI.

Table 4.2-29 Summary of effects Alternatives 1 through 5 on squid and other species in the BSAI.

Species Group	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Squid	U/U	U/U	U/U	U/U	U/U
Skates	U/I	U/I	U/I	U/I	U/I
Sculpins	U/I	U/I	U/I	U/I	U/I
Sharks	U/U	U/U	U/U	U/U	U/U
Octopi	U/U	U/U	U/U	U/U	U/U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

The first rating is for the effects on populations and the second on the likelihood of change in incidental catch

4.2.5.6.2 Gulf of Alaska Other Species

4.2.5.6.2.1 Effects of Alternatives 1 through 5 on Gulf of Alaska Other Species

In the GOA, the Other species category includes squid, skates, sculpins, sharks, and octopus. No formal stock assessment is conducted for these species at present, so TAC is set as 5% of the sum of all GOA target species TACs each year. Catches of GOA Other species have generally been well below the TAC set in this manner. Reporting is required in aggregate for species in this category, meaning all catch regardless of species is officially reported as "other" (including squid in the GOA). Observer data was used to estimate the catch of each Other species group to assess the potential effects of the alternatives on squid, sculpins, skates, sharks, and octopus separately. Because little formal stock assessment information exists for most species in this category, the impacts to each species group were assessed in terms of the relative magnitude of bycatch. In the absence of better information, reductions in bycatch of these species was viewed as generally positive, and increases in bycatch as generally negative impacts of alternative management measures, but the actual population effects of changes in bycatch cannot be determined. In addition, there is much less observer coverage in the GOA overall relative to the BSAI due to the size distribution of vessels, so that sampling issues which made it difficult to estimate other species catch under different alternatives in the BSAI are magnified in the GOA.

As in the BSAI, most squid bycatch in the GOA is taken in pelagic trawl fisheries directed at pollock. However, the magnitude of squid catch in the GOA is estimated at less than 100 mt per year, or about one tenth the BSAI catch. It was assumed that squid catch rates would generally scale with pollock catch rates in assessing the differences between alternatives. In the GOA, pollock catch is predicted to be lowest under Alternative 2, so that reductions in squid bycatch are possible under this alternative. All other alternatives maintain pollock catch at higher levels, so that squid bycatch might remain similar to what we observe now. Squid catch is currently so low in the GOA that any differences between years or alternatives may be just as easily attributed to measurement error as to management or squid population dynamics. Therefore, no real

differences can be discerned between alternatives with respect to squid catch in the GOA, and the impact of this bycatch on squid populations remains unknown.

Skate bycatch represents the majority of Other species catch in the GOA as it does in the BSAI, although the magnitude of catches in the GOA is estimated at 3,000 to 5,000 mt annually. Skate catch in the GOA is more evenly distributed between longline fisheries for sablefish and Pacific cod than it is in the BSAI, so alterations to Pacific cod fisheries alone might be expected to have smaller effects on overall skate catch here. Since lower cod catch is predicted for Alternative 2, it is possible that skate bycatch might also be reduced under this alternative. All other alternatives maintain Pacific cod bycatch at higher levels and may even increase sablefish catch somewhat, so it is expected that skate bycatch would remain similar to currently observed levels under these alternatives. As with skates in the BSAI, it cannot be discerned if any changes in bycatch would have any effect on GOA skate populations. Further, since skates are not identified to species in the catch, it cannot be determined if all GOA skate species (there are at least 11 species identified in the area) are likely to see changes in bycatch under the alternatives, or if some species might be caught more while others are caught less due to the redistribution of the fisheries.

Sculpins are caught primarily in GOA bottom trawl fisheries directed at flatfish and Pacific cod. Sculpin catch is much lower in the GOA than in the BSAI, at less than 1,000 mt per year. The alternatives would appear to affect sculpin bycatch similarly to skate bycatch, so that it is likely to remain similar to currently observed levels. It cannot be determined how the size and species composition of sculpin bycatch might change under any alternative because it is not known what these are now. All of the caveats that apply to the skate estimates discussed above also apply to sculpins; and it cannot be determined what effects the projected changes in bycatch under any alternative might have on GOA sculpin populations.

Shark bycatch is higher in the GOA than in the BSAI, averaging about 1,500 mt between 1997-1999. Catch of both salmon sharks and spiny dogfish is much higher in the GOA relative to the BSAI, while the magnitude of sleeper shark and unidentified sharks is similar between the BSAI and the GOA. Most salmon sharks are caught in the pelagic trawl pollock fisheries, while most spiny dogfish are caught in flatfish and pollock trawl fisheries, with some catch in sablefish longline fisheries. Given that pollock fisheries are reduced under Alternative 2, it is possible that there may be less salmon shark bycatch under this alternative. However, similar sampling issues apply here as discussed above in the BSAI, especially considering the lower observer coverage in the GOA relative to the BSAI. It is also possible that reallocating the catch of target species into different areas and seasons will result in displacement into areas of higher or lower historical shark bycatch rates in the GOA, where catch of spiny dogfish is especially patchy. Therefore, actual shark bycatch under any of the proposed alternatives is difficult to predict with any precision, although it is expected it would remain similar to currently observed levels because overall fishing remains similar. There is no reliable estimate of shark biomass in the Gulf of Alaska, so although most sharks are identified to species in the catch, it cannot be determined what effects if any these changes in bycatch would have on shark populations in the GOA.

Octopus are primarily caught in pot fisheries targeting Pacific cod in the GOA, as in the BSAI. Bycatch of octopus in the GOA is thought to be low, averaging less than 200 mt annually. However, estimates of octopus catch are highly variable from year to year. As in the BSAI, Alternatives 2 and 3 appear to be more restrictive of Pacific cod pot fisheries than the other alternatives, so these alternatives may result in slightly lower octopus bycatch than alternatives which do not restrict pot fisheries. Conversely, if more Pacific cod TAC is allocated to pot gear under a given alternative, octopus bycatch may increase. These projections are based on overall average bycatch rates recently observed in Pacific cod pot fisheries; however, octopus bycatch is difficult to estimate because pot fisheries have only 30% observer coverage required under the

best of circumstances. Therefore, actual octopus bycatch under any of the proposed alternatives is difficult to predict with any precision. Furthermore, because there is no reliable biomass estimate for octopus species in the Gulf of Alaska, it cannot be determined whether these changes would have any effects at all on octopus populations.

4.2.5.6.2.2 Summary of Effects on Gulf of Alaska and Other Species

The criteria used to estimate the significance of impacts of Alternatives 1 through 5 on the GOA stocks of other species are outlined in Table 4.2-3. Table 4.2-30 summarize the effects of Alternatives 1 through 5 on other species stocks and incidental catch in the GOA.

Table 4.2-30 Summary of effects of Alternatives 1 through 5 on other species in the GOA.

Species Group	Alt. 1	Alt. 2	Alt.3	Alt. 4	Alt. 5
Squid	U/U	U/U	U/U	U/U	U/U
Skates	U/U	U/U	U/U	U/U	U/U
Sculpins	U/I	U/I	U/I	U/I	U/I
Sharks	U/I	U/I	U/I	U/I	U/I
Octopi	U/U	U/U	U/U	U/U	U/U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

The first rating is for the effects on populations and the second on the likelihood of change in incidental catch

4.3 Effects on Incidental Catch of Non-Specified Species

The alternatives being analyzed all contain differing approaches to the management of pollock, Pacific cod, and Atka mackerel fisheries in the BSAI and the Pacific cod and pollock fisheries in the GOA with the principal goal of providing adequate protection for the endangered western population of Steller sea lions. Each alternative addresses four general topics; how to best spread the fisheries out over the fishing year, how to best disperse the fisheries over a greater area, how to best establish TAC levels for the targeted fisheries, and in which areas to close directed fishing on the targeted fish.

The information available for non-specified species is extremely limited. Estimates of biomass, seasonal distribution of biomass, and natural mortality are unavailable for most non-specified species. Predictions of impacts from the different management measures contained in the alternatives, such as the effects of the redistribution of fishing effort over greater area and time spans, are therefore qualitatively described. Management concerns, data limitations, research in progress, and planned research to address these concerns are discussed in Section 4.5 of the Draft Programmatic SEIS (NMFS, 2001a). Direct effects include the removal of non-specified species from the environment as incidental catch in the Pacific cod, pollock, and Atka mackerel fisheries. The same criteria for evaluating significance were used in both the BSAI and GOA analyses (Table 4.3-1). Indirect effects would include habitat disturbance by fishing gear and disruption of food web interactions by disproportionate removal of one or more trophic levels, though no attempt was made to evaluate the significance of indirect effects. Insufficient information exists to estimate the indirect effects of changes in the incidental catch of non-specified species under all alternatives considered. The alternatives set TAC for target species at different levels and comparisons can be made of the expected

changes in the amount of incidental catch of non-specified species based on the average catch from 1997 to 1999 (NMFS, 2001a) with changes in examples of TAC levels in section 2.3 of this SEIS.

4.3.1 Effects on Non-specified Species in the BSAI

The average incidental catch of non-specified species from 1997 to 1999 was 23,076 mt, about 1.4% of the total catch in the BSAI groundfish fisheries. The breakdown in into smaller groups yields 6,610 mt grenadiers (28.6%), 1,420 mt other non-specified species (6.2%), 7,717 mt jellyfish (33.5%), 1,615 mt sessile invertebrates (7.0%), 4,412 mt mobile invertebrates (19.1%), and 1,546 mt unidentified invertebrates (6.7%). More than 50% of the bycatch of jellyfish occurs in the pollock fishery. Of the total incidental catch of grenadiers, 10% is taken in the Pacific cod fishery, 1% in the pollock fishery, and less 1% in the Atka mackerel fishery (NMFS, 2001a). Additional information on incidental catch of non-specified species in other directed groundfish fisheries is not available. Results of significance evaluations on non-specified species in the BSAI are summarized in Table 4.3-2.

4.3.1.1 Effects of Alternative 1 on Non-specified Species in the BSAI

Under Alternative 1 - No Action, there would be no change in the manner in which TACs are set and it is unlikely that incidental catch levels of non-specified species would increase or decrease by more than 20%, therefore the effect of Alternative 1 on incidental catch levels is rated insignificant (I) for all groups of non-specified species considered. The effect of the present incidental catch rates on stocks of non-specified species is unknown (U) under Alternative 1 and all other alternatives as well because estimates of biomass, seasonal distribution of biomass, and natural mortality are unavailable for all groups of non-specified species considered (Table 4.3-2).

4.3.1.2 Effects of Alternative 2 on Non-specified Species in the BSAI

Under Alternative 2 - Low and Slow Approach, in Section 2.3 of this SEIS, a 3.5% reduction in the BSAI pollock TAC, a 28% reduction in the BSAI Pacific cod TAC, and a 39% reduction in the BSAI Atka mackerel TAC under Alternative 2 are predicted. Alternative 2 also contains daily catch limitations, limitations on catch within Steller sea lion critical habitat, gear and area closures which may result in the TACs not being fully harvested. Because most jellyfish are taken in the pollock fishery a reduction in pollock TAC and the failure to fully harvest that TAC could reduce the incidental catch level of jellyfish by more than 20% and is therefore rated as conditionally significant (beneficial, CS+). A 28% reduction in the Pacific cod TAC is assumed would result in a proportionate in a 28% reduction of the incidental catch of grenadiers in the Pacific cod fishery from 10% to 7% of the total grenadier incidental catch. A decrease in the TAC and harvest of pollock, Pacific cod, and Atka mackerel, however, could lead to an increase in the TACs awarded to other groundfish target species because they would not be as constrained by the 2,000,000 mt limit for annual groundfish harvest in the BSAI. Any reductions in incidental catch of non-specified species in the pollock, Pacific cod, and Atka mackerel fisheries may be offset by increases in other groundfish fisheries. For this reason the effects of Alternative 2 on incidental catch levels of all non-specified species groups considered (except jellyfish) are rated as unknown (U, Table 4.3-2).

4.3.1.3 Effects of Alternative 3 on Non-specified Species in the BSAI

Under Alternative 3 - Restricted and Closed Areas Approach, there would be no change in the manner in which TACs are set and it is unlikely that incidental catch levels of non-specified species would change significantly with the possible exception of jellyfish in the pollock fishery. Alternative 3 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of jellyfish by more than 20% and the effect on this group of species is rated conditionally significant (beneficial, CS+). Because the seasonal distribution of non-specified species is unknown, the effect of displacing fishing from inside to outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of non-specified species considered (with the exception of jellyfish) by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (I, Table 4.3-2).

4.3.1.4 Effects of Alternative 4 on Non-specified Species in the BSAI

Under Alternative 4 - Area and Fishery Specific, there would be no change in the manner in which TACs are set, and it is unlikely that incidental catch levels of non-specified species would change significantly with the possible exception of jellyfish in the pollock fishery. Alternative 4 includes area closures within Steller sea lion critical habitat and seasonal harvest limits which could result in the failure to fully harvest the pollock TAC which in turn could reduce the incidental catch of jellyfish, although not to the extent of Alternatives 2 or 3. Because the seasonal distribution of non-specified species is unknown, the effect of seasonally displacing fishing effort inside and outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of non-specified species considered by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (I, Table 4.3-2).

4.3.1.5 Effects of Alternative 5 on Non-specified Species in the BSAI

Under Alternative 5 - Critical Habitat Catch Limit Approach, there would be no change in the manner in which TACs are set with the exception of setting the Aleutian Islands TAC at a level sufficient for incidental catch in other directed fisheries. It is unlikely that incidental catch levels of non-specified species would change significantly with the possible exception of jellyfish in the pollock fishery. Alternative 5 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of jellyfish, although not to the extent of Alternatives 2 or 3. Because the seasonal distribution of non-specified species is unknown, the effect of displacing fishing from inside to outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of

non-specified species considered by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (I, Table 4.3-2).

4.3.1.6 Summary of Effects on Non-specified Species in the BSAI

Biomass estimates are not available for species included in this category therefore quantitative estimates of the effects of the alternatives considered cannot be made, and are rated as unknown. Table 4.3-1 outlines the criteria used to qualitatively describe the potential for significant change in the amount of incidental catch of non-specified species. The 1997 to 1999 average catch is used as the baseline for purposes of comparison (NMFS 2001a).

Criteria were developed and used to describe the potential for significant change in the harvest levels of non-specified species. If the alternative is considered likely to decrease catch by half it was deemed to have a significantly beneficial effect (S+). If the alternative is considered likely to increase catch by half it was deemed to have a significantly adverse effect (S-). If the alternative is considered likely to increase or decrease catch by more than 20% but less than 50% it was deemed either conditionally significant beneficial (CS+) or adverse (CS-). If the alternative is considered likely to increase or decrease catch by less than 20% it was deemed insignificant (I). When insufficient information exists to forecast the effect of the alternative on incidental catch the effect is unknown (U). (Table 4.3-1). These criteria are qualitative in nature, an anticipated increase or decrease in harvest levels of more than 50 % is thought to be a substantial change and is deemed significant. An anticipated increase or decrease in harvest levels of between 20% and 50% may constitute a substantial change and is deemed conditionally significant. An anticipated increase or decrease of less than 20% is deemed insignificant as fluctuations of biomass levels frequently occur within this range over several years.

In section 4.5 of the Draft Programmatic SEIS (NMFS, 2001a), the extremely diverse group of organisms included in the non-specified category were subdivided into five smaller groups; grenadiers, other non-specified species (eelpouts, poachers, lumpsuckers, etc.), jellyfish, sessile benthic organisms (corals, sponges, anemones, etc.), and mobile benthic organisms (non-prohibited crab, shrimp, echinoderms, etc). Where possible, these subdivisions are also used for this analysis along with 2000 to 2005 projected average incidental catch of all non-specified species (NMFS, 2001a).

Table 4.3-1 Criteria used to describe significance of impacts on incidental catch levels of non-specified species in both the BSAI and GOA.

Issue	Effect	Significant	Conditionally Significant (beneficial)	Conditionally Significant (adverse)	Insignificant	Unknown
Non-specified Species Incidental Catch	Direct	Substantial difference in bycatch (+>50% or -> 50%) removal.	Marginally less (>-20%-50%) bycatch removal.	Marginally more (>+20%-50%) bycatch removal.	No substantial difference in bycatch (0-20%) removal.	Insufficient information available

Note: The Conditionally Significant rating reflects both defined criteria and a level of uncertainty in estimating effects.

Table 4.3-2 Summary of effects of Alternatives 1 through 5 on non-specified species in the BSAI.

Species Group	Question	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Grenadiers	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	U	I	I	I
Other non-specified Species	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	U	I	I	I
Jellyfish	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	CS+	CS+	I	I
Sessile Invertebrates	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	U	I	I	I
Mobile Invertebrates	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	U	I	I	I
Total non-specified	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	U	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.3.2 Effects on Non-specified Species in the GOA

The average incidental catch of non-specified species from 1997 to 1999 was 17,436 mt, about 6.7% of the total catch in the GOA groundfish fisheries. The breakdown into smaller groups yields 12,700 mt grenadiers (72.8%), 3,265 mt other non-specified species (18.7%), 103 mt jellyfish (0.6%), 31 mt sessile invertebrates (0.2%), 1,287 mt mobile invertebrates (7.3%), and 50 mt unidentified invertebrates (0.3%). More than 50% of the bycatch of jellyfish occurs in the pollock fishery. Of the total incidental catch of grenadiers, 2% is taken in the Pacific cod fishery and less than 1% in the pollock fishery (NMFS, 2001a). Additional information on incidental catch of non-specified species in other groundfish target fisheries is not available. Criteria established for rating significance of effects on non-specified species in the GOA are summarized in Table 4.3-1. Results of significance evaluations on non-specified species in the GOA are summarized in Table 4.3-3.

4.3.2.1 Effects of Alternative 1 on Non-specified Species in the GOA

Under Alternative 1 - No Action, there would be no change in the manner in which TACs are set and it is unlikely that incidental catch levels of non-specified species would increase or decrease by more than 20%, therefore the effect of Alternative 1 on incidental catch levels is rated insignificant (I) for all groups of non-specified species considered (Table 4.3-3). The effect of the present incidental catch rates on stocks of non-specified species is unknown (U) under Alternative 1 and all other alternatives as well because estimates of biomass, seasonal distribution of biomass, and natural mortality are unavailable for all groups of non-specified species considered (Table 4.3-3).

4.3.2.2 Effects of Alternative 2 on Non-specified Species in the GOA

Under Alternative 2 - Low and Slow, in Section 2.3 in this SEIS, a 54,481 mt (55%) reduction in the GOA pollock TAC and a 19,209 mt (38%) reduction in the GOA Pacific cod TAC are predicted. Alternative 2 also contains daily catch limitations, limitations on catch within Steller sea lion critical habitat, gear and area closures which would result in the TACs not being fully harvested. Altogether total harvest of targeted species could decrease by approximately 100,000 mt annually, a reduction from 1997 to 1999 average catch (233,884 mt) of about 43%. Because most jellyfish are taken in the pollock fishery a reduction in pollock TAC and the failure to fully harvest that TAC could reduce the incidental catch level of jellyfish by more than 50%, using the criteria in Table 4.3-1 this results in a rating of beneficially significant (S+) . A 38% reduction in the Pacific cod TAC is assumed would result in a proportionate 38% reduction of the incidental catch of grenadiers in the Pacific cod fishery from about 2% to 1% of the total grenadier incidental catch. A decrease in the TAC and harvest of pollock and Pacific cod would, however, allow hook-and-line and trawl PSC halibut allowances to be used to target other deep water and shallow water target species, offsetting the likelihood that incidental catch of grenadiers would decrease by more than 20 % (I) and partially offsetting the likelihood that incidental catch of other non-specified species would decrease by more than 50% (CS+, Table 4.3-3).

4.3.2.3 Effects of Alternative 3 on Non-specified Species in the GOA

Under Alternative 3 - Restricted and Closed Areas Approach, in Section 2.3 in this SEIS a decrease of about an 18% decrease in the pollock TACs are predicted. It is unlikely that incidental catch rates of non-specified species would change significantly with the possible exception of jellyfish in the pollock fishery. Alternative 3 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of jellyfish by more than 20% and the effect on this group of species is rated conditionally significant (beneficial, CS+). Because the seasonal distribution of non-specified species is unknown, the effect of displacing fishing from inside to outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of non-specified species considered (with the exception of jellyfish) by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (Table 4.3-3).

4.3.2.4 Effects of Alternative 4 on Non-specified Species in the GOA

Under Alternative 4 - Area and Fishery Specific, there would be no change in the manner in which TACs are set and it is unlikely that incidental catch rates of non-specified species would change significantly with the possible exception of jellyfish in the pollock fishery. Alternative 4 includes area closures within Steller sea lion critical habitat and seasonal harvest limits which could result in the failure to fully harvest the pollock TAC which in turn could reduce the incidental catch of jellyfish, although not to the extent of Alternatives 2 or 3. Because the seasonal distribution of non-specified species is unknown, the effect of seasonally displacing fishing effort inside and outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of non-specified species considered by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (I, Table 4.3-3).

4.3.2.5 Effects of Alternative 5 on Non-specified Species in the GOA

Under Alternative 5 - Critical Habitat Catch Limit Approach, there would be no change in the manner in which TACs are set and it is unlikely that incidental catch rates of non-specified species would significantly change with the possible exception of jellyfish in the pollock fishery. Alternative 5 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of jellyfish, although not to the extent of Alternatives 2 or 3. Because the seasonal distribution of non-specified species is unknown, the effect of displacing fishing from inside to outside Steller sea lion critical habitat during portions of the year on other groups of non-specified species considered changes in incidental catch levels cannot be precisely determined. However near shore marine communities (within Steller sea lion critical habitat) are, in general, more biologically diverse than marine communities farther offshore and the net result of displacing fishing effort would not be expected to increase or decrease the incidental catch of the groups of non-specified species considered by more than 20%. Therefore the effect on incidental catch levels for these groups of non-specified species is rated insignificant (I, Table 4.3-3).

4.3.2.6 Summary of Effects on Non-specified Species in the GOA

Biomass estimates are not available for species included in this category therefore quantitative estimates of the effects of the alternatives considered cannot be made, and are rated unknown. The criteria used to qualitatively describe the potential for significant change in the amount of incidental catch of non-specified species are summarized in Table 4.3-1. The 1997 to 1999 average catch is used as the baseline for purposes of comparison (NMFS 2001a).

In section 4.5 of the Draft Programmatic SEIS (NMFS, 2001a) the extremely diverse group of organisms included in the non-specified category were subdivided into five smaller groups; grenadiers, other non-specified species (eelpouts, poachers, lumpsuckers, etc.), jellyfish, sessile benthic organisms (corals, sponges, anemones, etc.), and mobile benthic organisms (non-prohibited crab, shrimp, echinoderms, etc.). Where possible, these subdivisions are also used for this analysis along with 2000 to 2005 projected average incidental catch of all non-specified species (NMFS, 2001a).

Table 4.3-3 Summary of effects of Alternatives 1 through 5 on non-specified species in the GOA.

Species Group	Question	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Grenadiers	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	I	I	I	I
Other non-specified species	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	CS+	I	I	I
Jellyfish	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	S+	CS+	I	I
Sessile Invertebrates	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	CS+	I	I	I
Mobile Invertebrates	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	CS+	I	I	I
Total non-specified	effects on populations	U	U	U	U	U
	likelihood of change in incidental catch	I	CS+	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.4 Effects on Forage Fish Species

The alternatives being analyzed all contain differing approaches to the management of pollock, Pacific cod, and Atka mackerel fisheries in the BSAI and the Pacific cod and pollock fisheries in the GOA with the principal goal of providing adequate protection for the endangered western population of Steller sea lions. Each alternative addresses four general topics; how to best spread the fisheries out over the fishing year, how to best disperse the fisheries over a greater area, how to best establish TAC levels for the targeted fisheries, and in which areas to close directed fishing on the targeted fish.

In this analysis the definition of forage fish species is limited to those species included in FMP Amendments 36 in the BSAI and 39 in the GOA. A great many other species occupy similar trophic levels in the food chain to forage fish as species preyed upon by higher trophic levels at some period during their life history, such as juvenile pollock and Pacific cod. These species are discussed elsewhere in this SEIS and are not further discussed in this section. The information available for forage fish species is extremely limited. Estimates of biomass and seasonal distribution of biomass are unavailable for forage fish species. Therefore the effects of the different management measures contained in the alternatives, such as the effects of the redistribution of fishing effort over greater area and time spans, cannot be quantitatively described. Management concerns, data limitations, research in progress, and planned research to address these concerns are discussed in Section 4.5 of the draft SEIS (NMFS, 2001a). Direct effects include the removal of forage fish species from the environment as incidental catch in the Pacific cod, pollock, and Atka mackerel fisheries. The same criteria for evaluating significance were used for both the BSAI and GOA (Table 4.4-1). The 1997 to 1999 average catch is used as the baseline for purposes of comparison (NMFS 2001a). Indirect effects would include habitat disturbance by fishing gear and disruption of food web interactions by disproportionate removal of one or more trophic levels. There is insufficient information available to

estimate the indirect effects of changes in the incidental catch of forage species under all alternatives considered. Even though the amount of biomass and seasonal distribution is unknown for the individual forage fish groups, the small amount of average incidental catch (1997 to 1999) in the BSAI of 39 mt and in the GOA of 61 mt is not likely to effect stocks (abundance) of forage fish species by more than 20% and is rated insignificant (I) under all alternatives considered (Table 4.4-2). In both the BSAI and the GOA more than 90% of the incidental catch by weight of all forage fish species are smelt taken in pollock fisheries. The alternatives set TAC for target species at different levels and comparisons can be made of the expected changes in the amount of incidental catch of forage fish species based on the average catch from 1997 to 1999 (NMFS, 2001a) with changes in examples of TAC levels in section 2.3 of this SEIS.

4.4.1 Effects of Alternative 1 on Forage Fish Species

Under Alternative 1 - No Action, there would be no change in the manner in which the pollock TACs are set and it is unlikely that incidental catch rates and amounts of forage fish species would increase or decrease by more than 20%, therefore the effects of Alternative 1 incidental catch levels of forage fish species is rated insignificant (I, Table 4.4-2).

4.4.2 Effects of Alternative 2 on Forage Fish Species

Under Alternative 2 - Low and Slow, in the description of alternatives in Section 2.3 in this SEIS there would be a 3.5% reduction in the BSAI pollock TAC, a 28% reduction in the BSAI Pacific cod TAC, and a 39% reduction in the BSAI Atka mackerel TAC. In the GOA there would be a 54,481 mt (55%) reduction in the GOA pollock TAC and a 19,209 mt (38%) reduction in the GOA Pacific cod TAC. Alternative 2 also contains daily catch limitations, limitations on catch within Steller sea lion critical habitat, gear and area closures which could result in the TACs not being fully harvested. Since most smelt are taken in the pollock fishery a reduction in the pollock TACs and a failure to fully harvest the available TACs could reduce the incidental catch of smelt. A 3.5% reduction in the pollock TAC in the BSAI is not likely, of itself, to appreciably reduce the incidental catch of smelt, however when coupled when couple with restrictions on the use of trawl gear, daily catch limits, and a closure of the AI to pollock fishing, the pollock TACs might not be fully utilized which could reduce the incidental catch of smelt. In the BSAI these management measures in concert would be expected to reduce the incidental harvest of smelt by more than 20% but probably less than 50 % and is rated conditionally significant (beneficial, CS+). In the GOA the pollock TAC reduction of 55% coupled with a closure of trawl pollock fishing within the Shelikof Straight (which equates to a further TAC reduction of 10,562 mt or 11%) and other Steller sea lion critical habitat would be expected to reduce the incidental catch of smelt by more than 50% half, and is rated beneficially significant (S+, Table 4.4-2).

A decrease in the TAC and harvest of pollock, Pacific cod, and Atka mackerel in the BSAI could lead to an increase in the TACs of other groundfish targets up to the cumulative 2,000,000 mt limit. Any reductions in incidental catch of other forage fish species in the pollock, Pacific cod, and Atka mackerel fisheries could be offset by increases in other BSAI groundfish fisheries. In the GOA a decrease in the TACs and harvests of pollock and Pacific cod would allow hook-and-line and trawl PSC halibut allowances to be used to target other groundfish targets potentially offsetting the likelihood that incidental catch of other forage fish species would decrease. For other forage fish species groups in the BSAI and GOA incidental catch levels would not be expected to increase or decrease by more than 20% and are rated insignificant (I, Table 4.4-2).

4.4.3 Effects of Alternative 3 on Forage Fish Species

Under Alternative 3 - Restricted and Closed Areas Approach, there would be no change in the manner in which TACs are set in the BSAI and it is unlikely that incidental catch rates of forage fish species would change significantly with the possible exception of smelt fish in the pollock fishery. Alternative 3 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of smelt in the BSAI. Since the seasonal distribution of forage species is unknown the effect on displacing fishing vessels from inside to outside Steller sea lion critical habitat during portions of the year on incidental catch rates cannot be determined. For forage fish species groups in the BSAI incidental catch levels would not be expected to increase or decrease by more than 20% and are rated insignificant (I, Table 4.4-2). In Section 2.3 of this SEIS examples of TAC the GCL is applied to the GOA pollock stock resulting in a TAC reduce of about 18% which when combined with area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of smelt in the GOA. Under Alternative 3 changes in the incidental catch level of smelt would be expected to decrease by more than 20% but probably less than 50% and is rated as conditionally significant (beneficial, CS+). For other forage fish species groups in the incidental catch levels would not be expected to increase or decrease by more than 20% and are rated insignificant (I, Table 4.4-2).

4.4.4 Effects of Alternative 4 on Forage Fish Species

Under Alternative 4 - Area and Fishery Specific, there would be no change in the manner in which TACs are set in both the BSAI and GOA and it is unlikely that incidental catch rates of forage fish species would change significantly with the possible exception of smelt in the pollock fisheries. Alternative 4 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of smelt, although not to the extent of Alternatives 2 or 3. Since the seasonal distribution of non-specified species is unknown the effect on displacing fishing vessels from inside to outside Steller sea lion critical habitat during portions of the year on incidental catch rates cannot be determined. For other forage fish species groups in the BSAI and GOA incidental catch levels would not be expected to increase or decrease by more than 20% and are rated insignificant (I, Table 4.4-2).

4.4.5 Effects of Alternative 5 on Forage Fish Species

Under Alternative 5 - Critical Habitat Catch Limit Approach, there would be no change in the manner in which TACs are set with the exception of pollock in the Aleutian Islands area. It is unlikely that incidental catch rates of forage fish species would change significantly with the possible exception of smelt in the pollock fishery. Alternative 5 includes area closures and seasonal harvest limits within Steller sea lion critical habitat which could result in the failure to fully harvest the pollock TAC which could reduce the incidental catch of smelt, although not to the extent of Alternatives 2 or 3. Since the seasonal distribution of non-specified species is unknown the effect on displacing fishing vessels from inside to outside Steller sea lion critical habitat during portions of the year on incidental catch rates cannot be determined. For other forage fish species groups in the BSAI and GOA incidental catch levels would not be expected to increase or decrease by more than 20% and are rated insignificant (I, Table 4.4-2).

4.4.6 Summary of Effects on Forage Fish Species

Biomass estimates are not available for species included in this category therefore quantitative estimates of the effects of the alternatives on stocks of forage fish species considered cannot be made, but are assumed to be insignificant (I) under all alternatives due to the low volume of incidental catch. The following criteria were used to describe the potential for significant change in the harvest levels of forage fish species. If the alternative is considered likely to decrease catch by half it was deemed to have a significantly beneficial effect (S+). If the alternative is considered likely to increase catch by half it was deemed to have a significantly adverse effect (S-). If the alternative is considered likely to increase or decrease catch by more than 20% but less than 50% it was deemed either conditionally significant beneficial (CS+) or adverse (CS-). If the alternative is considered likely to increase or decrease catch by less than 20% it was deemed insignificant (I). When insufficient information exists to forecast the effect of the alternative on incidental catch the effect is unknown (U). (Table 4.4-1). These criteria are qualitative in nature, an anticipated increase or decrease in harvest levels of more than 50% is thought to be a substantial change and is deemed significant. An anticipated increase or decrease in harvest levels of between 20% and 50% may constitute a substantial change and is deemed conditionally significant. An anticipated increase or decrease of less than 20% is deemed insignificant as fluctuations of biomass levels frequently occur within this range over several years.

Table 4.4-1 Criteria used to describe significance of impacts on incidental catch levels of forage fish species

Issue	Effect	Significant	Conditionally Significant* (beneficial)	Conditionally Significant* (adverse)	Insignificant	Unknown
Forage Fish Species Incidental Catch	Direct	Substantial difference in bycatch (+>50% or -> 50%) removal.	Marginally less (>-20%-50%) bycatch removal.	Marginally more (>+20%-50%) bycatch removal.	No substantial difference in bycatch (+-0-20%) removal.	Insufficient information available

*The "Conditionally Significant" category reflects both defined criteria and a level of uncertainty in estimating effects. 1997 to 1999 average catch is used as the baseline for purposes of comparison (NMFS 2001a).

In section 4.5 of the draft programmatic SEIS (NMFS, 2001a) forage fish were subdivided in two groups; smelts and all other forage fish. Where possible, these subdivisions are used here along with 2000 to 2005 projected average incidental catch of all non-specified species (NMFS, 2001a). These effects in the BSAI and GOA are summarized in Table 4.4-2.

Table 4.4-2 Summary of effects on forage fish species in the BSAI and GOA.

Forage Fish/Area	Question	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Smelt/BSAI	Effect on populations	I	I	I	I	I
	Likelihood of change in incidental catch	I	CS+	I	I	I
Other FF/BSAI	Effect on populations	I	I	I	I	I
	Likelihood of change in incidental catch	I	I	I	I	I
Smelt/GOA	Effect on populations	I	I	I	I	I
	Likelihood of change in incidental catch	I	S+	CS+	I	I
Other FF/GOA	Effect on populations	I	I	I	I	I
	Likelihood of change in incidental catch	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.5 Effects on Prohibited Species Bycatch

Prohibited species taken incidentally, or as bycatch, in groundfish fisheries include: Pacific salmon (chinook, coho, sockeye, chum, and pink salmon), steelhead trout, Pacific halibut, Pacific herring, and Alaska king, Tanner, and snow crabs. Background information on these species is provided in section 3.5. Discussion of the effects of the alternatives on the bycatch of prohibited species in the Bering Sea and Aleutian Islands Area (BSAI) and the Gulf of Alaska Area (GOA) are provided separately in sections 4.5.1 and 4.5.2, respectively.

Prohibited species bycatch is a function of the rate at which a prohibited species is encountered per metric ton of groundfish caught. Bycatch rates can be area and time specific, so that for instance, a higher bycatch rate for chinook salmon can be expected in the vicinity of Unimak Island and the 200 m depth contour during the first four months of the year. The bycatch rate for chinook salmon is much lower in other areas of the Bering Sea during that period.

Implementation of the measures proposed under the various alternatives will have impacts on bycatch by moving fishing effort away from closed areas. If the new resulting fishing locations are away from areas of high bycatch rates, the subsequent bycatch levels should be reduced. Conversely, if fisheries are moved to locations with high bycatch rates, the bycatch levels should increase.

Data from the 1997 - 1999 groundfish fisheries were used in estimating changes in bycatch due to the various alternatives. Groundfish data from 1997 - 1999 were obtained from a database created by combining groundfish observer data, ADF&G fish tickets and federal weekly processor reports. The database was constructed to account for all groundfish catch in the BSAI and GOA while ensuring that the possibility of overlapping data sources, or duplicate data was minimized. The groundfish observer program is the only source for prohibited species bycatch numbers, and completely processed datasets that could be combined with the groundfish data were only available for 1998 and 1999.

The amount of groundfish and prohibited species bycatch was calculated inside and outside of the closure options under each alternative. The species catch by ADF&G statistical area was calculated for the pollock,

Atka mackerel and Pacific cod fisheries. A geographical information system (GIS) was used to overlay ADF&G statistical areas with 3, 10 and 20 nm buffers around all rookeries and haulouts. Coding allowed distinction of rookeries, haulouts and newer RPA listed haulouts. Each larger RPA site described in the 2001 biological opinion was also coded (NMFS 2000a). After merging the ADF&G statistical areas with rookery and haulout buffers, the resulting smaller area proportions (e.g. 12.0234% of a statistical area was within 3 nm of a rookery) were calculated so that the proportions for each ADF&G statistical area summed to one. The amount of catch within each closed area that did not conform perfectly with existing ADF&G statistical areas was apportioned based the percentage of a statistical area that lay within the closure zone. For instance in a statistical area for which 40% lay within a defined closed area (e.g. a 20 nm critical habitat buffer from a rookery), 40% of the catch from that statistical area would be considered to be from the closed area. Bycatch amounts were calculated similarly using observer data. The expected changes in bycatch levels were estimated by comparing bycatch rates in closed areas with the bycatch rates of the remaining open areas.

This chapter provides bycatch estimates for the Atka mackerel, Pacific cod and pollock fisheries. The use of historical bycatch rates based on location and fishery provides indications of how bycatch might change due to changes in fishing patterns under the various alternatives. However, the alternatives may cause changes in fisheries that could obscure the expected effects based solely on rates in the three fisheries under analysis. To illustrate the complex interactions of fisheries, the following hypothetical example provides a plausible scenario. If the trawl fishery for Pacific cod was closed earlier than might be expected due to a given alternative (reaching a bycatch cap, attainment of TAC, inability to harvest substantial portion of the TAC), the expected bycatch amounts of some species for that fishery might be reduced. However, the remaining allowance of halibut that the Pacific cod fishery did not take might be released to another fishery. This other fishery, for instance yellowfin sole, might then fish longer than in another scenario and incur high crab bycatch. Whereas the bycatch rates for an alternative might indicate a slight increase in crab bycatch in the Pacific cod fishery, there might be a substantial increase in crab bycatch under the alternative due overall fishery interactions. The effects of multiple fishery interactions on bycatch are not addressed in the current analysis.

4.5.1 Bering Sea and Aleutian Islands Area

Sections 4.5.1.1 - 4.5.1.5 below describing the effects of each alternative on BSAI bycatch will refer to Table 4.5-1 which presents the percentage change in bycatch levels expected under each of the alternatives. Prohibited species bycatch by alternative relative to the baseline (1997-1999 average) catch is first calculated for each species. Percentage values in the table are computed as the ratio of the change in *per-unit* catch of the bycatch species by alternative relative to the baseline catch. For example, let $U_{b,s,t}$ be the catch in target fishery t of species s for the Alternative data a . The values are computed for each species in Alternative 1 (where b represents the baseline data) as:

$$(U_{a,s,t} - U_{b,s,t}) / U_{b,s,t} .$$

To illustrate further a real example is done as follows:

$$U_{b,s=\text{halibut},t=\text{pollock}} = 553/941,282 = 0.000587$$

$$U_{1,s=\text{halibut},t=\text{pollock}} = 543/918,765 = 0.000591$$

$$(0.000591 - 0.000587) / 0.000587 = 0.00681 \sim 1\%$$

for the change in bycatch under Alternative 1 compared with the average estimated from 1997-1999. Crabs and salmon units are in numbers, all other species in metric tons.

It should be noted that the data are based on historic fishing patterns and management strategies. Non-pelagic trawl gear in the pollock fishery was banned in 2000, and was in effect in 1999 through the TAC setting process which allocated zero pollock to non-pelagic gear (65 FR 31105, May 16, 2000). The bycatch levels of crab and halibut that were present in the fishery in 1997 and 1998 are not expected to continue. For example, the bycatch of red king crab in 1998 of 13,950 crab was reduced to 91 crab in 1999 and 0 crab in 2000. The percentage changes in bycatch levels in Tables 4.5-1 and 4.5-5 may be similar to actual changes due to implementation of an alternative, however, the actual numbers should be significantly reduced from those indicated in the baseline data for the pollock fishery.

Also, expected increased catch of prohibited species for which prohibited species caps apply would result in earlier attainment of the PSC cap and then earlier closure of the fishery rather than an actual bycatch amount over the cap. This applies especially to halibut bycatch. For instance in the GOA, certain fisheries TACs are routinely not attained due to the constraints of the halibut bycatch caps. The fishery is in essence managed by the halibut allowance and caps rather than the directed fishery catch.

Table 4.5-1 The estimated change in bycatch levels in the BSAI when compared to the average estimated from 1997 and 1999

Pollock Fishery Catch of 941,282 Tons Stock	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Baseline Catch
Halibut	-2%	2%	6%	-23%	-3%	501
Herring	1%	-1%	-12%	16%	-9%	804
<i>C. bairdi</i> Crab	-4%	41%	26%	-6%	0%	105,227
Other Tanners	-3%	32%	26%	-8%	2%	202,469
Red king Crab	-11%	20%	33%	-20%	-6%	15,787
Other king Crab	1%	101%	32%	31%	7%	3,512
Chinook Salmon	0%	-59%	-33%	-9%	-6%	31,007
Other Salmon	2%	-35%	-26%	7%	1%	54,804

Pacific Cod Fishery Catch of 169,690 Tons Stock	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Baseline Catch
Halibut	1%	-20%	-6%	-11%	1%	1,579
Herring	3%	54%	31%	16%	2%	1
<i>C. bairdi</i> Crab	-7%	-21%	9%	-30%	-5%	73,554
Other Tanners	2%	36%	18%	4%	2%	560,926
Red king Crab	2%	26%	30%	5%	1%	8,261
Other king Crab	4%	65%	8%	18%	3%	28,052
Chinook Salmon	-5%	-49%	5%	-25%	-5%	2,222
Other Salmon	4%	-75%	-28%	-8%	4%	122

Atka Mackerel Fishery Catch of 56,473 Tons Stock	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Baseline Catch
Halibut	-12%	-30%	9%	-37%	-12%	117
Herring	19%	-100%	-100%	-42%	19%	0
Other Tanners	-4%	-100%	-100%	-65%	-4%	31
Other King Crab	18%	34%	-3%	23%	18%	2,260
Chinook Salmon	-78%	-91%	64%	-94%	-78%	266
Other Salmon	8%	-9%	-21%	-2%	8%	532

Note: Baseline units for crabs and salmon are in numbers; all other species are in metric tons. Other Tanners are mainly *C. opilio* crab, and other Salmon are primarily chum salmon.

Source: NMFS Catch by Vessel database (same as used to prepare Appendix E).

4.5.1.1 Effects of Alternative 1 on Prohibited Species Bycatch in the BSAI

Alternative 1 is the most similar to the fishing conditions present in 1997 - 1999, and the estimated impacts on bycatch by the alternatives are small for this alternative in terms of percentage change in expected bycatch levels (Table 4.5-1). Alternative 1, No Action, in essence mirrors many of the regulatory elements that were in place during the time the data were collected, so small percentage changes might be expected. In the pollock fishery, the largest percentage change from the baseline data was the bycatch of red king crab which was projected to decline by 11%. The bycatch of red king crab in the pollock fishery will be significantly reduced in future years due to the 2000 ban on non-pelagic trawl gear in this fishery discussed above.

Similarly, the predictions of bycatch changes in the Pacific cod fisheries indicate slight decreases in numbers of intercepted *C. bairdi* crab and chinook salmon, and slight increases in other species bycatch.

There were no critical habitat limitations on Atka mackerel fishing in the Aleutian Islands in 1997 or 1998. In 1999, a limit was made on the amount of Atka mackerel harvested in critical habitat to 65% of the seasonal allowance in the Western Aleutian Islands, and to 80% in the Central Aleutians (64 FR 3446, January 22, 1999). Further reductions on critical habitat limits were made to extend over a four year period in this final rule as well. Alternative 1 reduces the amount of Atka mackerel that can be taken in critical habitat to 40% of the directed fishing allowance. The decrease in critical habitat allowance under Alternative 1 is apparent in the predicted changes in bycatch levels in the Atka mackerel fishery. Fishing effort is moved outside of critical habitat compared to the historic catch 1997 - 1999. It appears that chinook salmon, other Tanner crab (*C. opilio*), and halibut bycatch rates are lower outside of critical habitat, and the shift in effort outside of critical habitat led to reductions in the expected bycatch of these three species. Although the percentage decrease in chinook salmon bycatch appears to be high (78%), the actual numbers of chinook salmon taken in the Aleutian Islands is relative low to begin with (baseline of 266 fish). Under Alternative 1 there would be expected to be a 19% rise in herring bycatch and a 18% rise in other king crab bycatch., however, the herring baseline catch for the Aleutian Islands is less than one ton.

4.5.1.2 Effects of Alternative 2 on Prohibited Species Bycatch in the BSAI

Alternative 2 prohibits trawling in the largest amount of area across the five alternatives. The pollock and Atka mackerel fisheries are prosecuted exclusively with trawl gear, and there is a component of the Pacific cod fishery that relies on trawl gear as well. This alternative predicts the greatest change in bycatch percentages in the trawl fisheries.

The critical habitat closed under Alternative 2 includes areas of high salmon bycatch and contains the Chinook Salmon Savings Area and the Chum Salmon Savings Area (section 3.5) which were defined based on the spatial locations of salmon bycatch. Chinook salmon bycatch would be expected to decline from the baseline by 59% in the pollock fishery and by 49% in the Pacific cod fishery under this alternative and a reduction in chum salmon bycatch of 35% in the pollock fishery and 75% in the Pacific cod fishery would be expected.

Halibut bycatch would be expected to be similar to the baseline in the pollock fishery, and decline in the Pacific cod fisheries. In general there would be an increase in crab bycatch, especially in red king crab and *C. opilio* because the bycatch of these species are spatially removed from the critical habitat areas closed under Alternative 2 and increased fishing due to displaced effort would lead to increases in bycatch. Red king crab bycatch would be predicted to increase by 20% in the pollock fishery and by 26% in the Pacific cod fisheries, although as noted above, the pollock fishery would not be expected to have appreciable crab bycatch in the future. Similarly other Tanner (*C. opilio*) bycatch would be expected to increase by 32% in the pollock fishery and 36% in the Pacific cod fisheries. Based on historic fishing patterns, other king crab bycatch in the Pacific cod fisheries would be expected to increase by 65% under Alternative 2 (and by 101% in the pollock fisheries, although that would not be the case in future pollock fisheries).

Pacific herring bycatch would be expected to decrease slightly under Alternative 2 in the pollock fisheries. A predicted increase of 54% in the Pacific cod fishery would not result in substantial amounts of herring bycatch since the baseline amount is one ton of herring.

All bycatch amounts in the Aleutian Islands Atka mackerel fishery would be predicted to decline under Alternative 2 with the exception of other king crab bycatch which would be expected to increase by 34%. In terms of actual numbers, the other king crab bycatch amount would be the most substantial change in any of the Atka mackerel bycatch species as well.

4.5.1.3 Effects of Alternative 3 on Prohibited Species Bycatch in the BSAI

Alternative 3 would close portions of critical habitat to all fishing, and would close a smaller area to trawling than Alternative 2. Similar to Alternative 2 above, Alternative 3 would lead to predicted decreases in the bycatch of Pacific herring, chinook salmon and other salmon (12%, 33%, and 26%, respectively) in the pollock fishery. This is because the areas of high salmon and herring bycatch are largely contained in closed areas under both alternatives, however, the area containing the chinook and chum salmon savings areas would be open under this alternative. Critical habitat catch restrictions within open critical habitat would move effort out of these high bycatch zones, resulting in some bycatch reductions. Alternative 3 would be expected to increase the bycatch of crab in the pollock fishery by 25% - 35% depending on the species, although such increases would not be expected in future fisheries as discussed above.

Alternative 3 would likely increase the bycatch of red king crab by 30% and other Tanners (*C. opilio*) by 18% in the Pacific cod fisheries. Pacific herring would be expected to increase by 31% under the alternative, however, the baseline herring amount is small (one metric ton). The bycatch of other species would be expected to increase by no more than 10% or decrease in the Pacific cod fishery. Alternative 3 is the only alternative under which the amount of bycaught chinook salmon might be expected to increase (by 5%).

The two species that would have predicted increases in bycatch levels in the Aleutian Islands Atka mackerel fishery under Alternative 3 were Pacific halibut (9% increase), and chinook salmon (64% increase). It should be noted that the baseline number for chinook salmon in the Atka mackerel fishery is 266 fish, so that a 64% increase would not result in a substantial number of chinook salmon.

4.5.1.4 Effects of Alternative 4 on Prohibited Species Bycatch in the BSAI

The complicated pattern of closure areas under Alternative 4 makes it difficult to explain the impacts that specific fisheries closures have on bycatch. Generally, less of the area where salmon and herring are bycaught remains closed, so that there is a predicted increase in other salmon bycatch of 7% and in herring bycatch of 16% in the pollock fishery. Chinook salmon bycatch on the other hand had an expected decrease of 9%, probably due to the 10 nm buffer zone in the vicinity of Unimak Island. The bycatch of all other species in the pollock fishery were predicted to decrease under this alternative (with the exception of other king crab bycatch, but again, existing and future management measures should keep the bycatch of crab in the pollock fisheries to a minimum).

In the fisheries for Pacific cod, Pacific halibut, Tanner crab (*C. bairdi*), chinook salmon and other salmon bycatch would all be expected to be reduced under this alternative (by 11%, 30%, 25%, and 8%, respectively). The bycatch of all other species would likely increase slightly, with higher level of 18% increase in other king crab bycatch. The 16% increase in herring is minimal due to the 1 mt of baseline bycatch.

The Atka mackerel fishery would have expected reductions of all species under Alternative 4 with the exception of an increase in the bycatch of other king crab by 23%.

4.5.1.5 Effects of Alternative 5 on Prohibited Species Bycatch in the BSAI

Alternative 5 increases the restrictions on trawl gear compared to Alternative 1, by including 10 or 20 nm buffers around 70 haulouts to be closed to pollock trawling. The percentage changes are relatively small in the pollock fishery, and the bycatch of Pacific herring and chinook salmon would be expected to decrease by 9% and 6%, respectively, with a small predicted increase in other salmon bycatch of 1%.

Similarly, the predicted changes in bycatch are small in the Pacific cod fishery with the highest percent changes being a 5% decrease in the bycatch of both Tanner crab (*C. bairdi*) and chinook salmon.

The expected effects on the Atka mackerel fishery are identical to those presented under 4.5.1.1 above.

4.5.1.6 Summary of Effects on Prohibited Species Bycatch in the BSAI

An explanation of the criteria used to describe the significance of impacts is summarized in Table 4.5-2. The significance of the predicted effects of the alternatives on prohibited species bycatch are presented in Table 4.5-3 for the Bering Sea pollock and Pacific cod fisheries, and 4.5.1.6-3 for Aleutian Islands Atka mackerel fisheries.

Chinook and other salmon are bycaught almost exclusively by trawl fisheries. The bycatch in the Aleutian Islands is considered insignificant, regardless of the alternative because of low bycatch numbers. Most of the alternatives resulted in expected decreases in salmon bycatch. The highest increase in chinook salmon bycatch was 5% under any alternative, and the highest predicted increase in other salmon was 7% under any alternative. Increases of this magnitude would not be practically detectable in the range of bycatch levels experienced in recent years, and are therefore, insignificant.

The bycatch of halibut in the BSAI is managed under caps allocated to specific fisheries, often on a seasonable basis. Since the bycatch of halibut is managed, it is not expected that bycatch levels would exceed historic or proscribed levels. The impacts of increased bycatch would therefore impact the fishery experiencing the higher bycatch and not the halibut resource itself.

Red king crab are intercepted primarily in Zone 1 of the Bering Sea, and bycatch levels are managed by a PSC cap for trawl fisheries in that area. The total estimated abundance of Bristol Bay red king crab in 2000 was 33.3 million crab (NMFS 2000d). Assuming that bycatch would need to exceed at least 1% of the population to be considered significant, 333,000 crab would need to be bycaught. Based on historical bycatch rates, this amount should not be approached. In addition, the existing Zone 1 PSC cap for red king crab is 89,725 crab for all fisheries combined, and the Pacific cod trawl allocation is 11,664 crab (Table 3.5-1). These caps would prevent the bycatch of red king crab from approaching significant levels, but would impact fisheries through directed fishery closures due to PSC cap attainment.

Similarly, Tanner (*C. bairdi*) and other Tanner (*C. opilio*) bycatch levels are managed by zonal caps in the Bering Sea. The total estimated abundance for Tanner (*C. bairdi*) crab in the Eastern Bering Sea was 36.7 million crab (NMFS 2000d). The Zone 1 cap for Tanner crab was set at 675,250 crab in 2001, and the Zone 2 cap at 1,914,750 crab (Table 3.5-4). The Pacific cod fishery allocation was 136,400 crab in Zone 1 and 225,941 crab in Zone 2 for a total PSC allotment of 362,341 crab, or approximately 1% of the overall 2000 estimated population. The baseline catch of Tanner crab in the Pacific cod fishery was approximately 175,000 crab, and the highest percentage of expected increase under any alternative was 41% which would

still be well below the PSC cap, and thus insignificant. The opilio cap was set at 4,023,750 crab for all fisheries, and at 24,736 crab for the Pacific cod trawl fishery (Table 3.5-5). The baseline catch of 560,926 is above this level, however, not all of the catch contributing to the baseline is from the trawl fishery. The highest increase in bycatch would lead to an earlier attainment of the cap triggering the closure of the C. Opilio Bycatch Limitation Zone, but should not lead to an increased bycatch of crab beyond the cap.

The overall bycatch limit for Pacific herring was set at 1% of the estimated Bering Sea biomass, or 1,525 mt in 2001 (Table 3.5-1), with 1,184 mt allocated to the pelagic pollock trawl fishery, the primary interception fishery for herring. Exceeding the PSC cap for Pacific herring results in the closure of seasonal Herring Savings Areas, designed to reduce further herring bycatch. The baseline bycatch of herring as a two-year average was 804 mt in the pelagic pollock fishery (Table 4.5-1). The highest predicted percent increase in herring bycatch of 16% would not result in the herring cap being reached and the closure being triggered.

Other king crab do not have bycatch restrictions other than protection of Blue king crab in the vicinity of the Pribilof Islands in the Pribilof Habitat Conservation Area that was designed to offer protection to their rearing halibut from trawl effects. Although there is a projected increase of 101% under Alternative 2 in the pollock fishery, the numbers are low, and pollock has been redefined to ban the use of non-pelagic trawl gear, so the impact is insignificant under this alternative. Elsewhere, other king crab bycatch has been low enough to be insignificant.

Bycatch levels in the Aleutian Islands subarea are low in the Atka mackerel fishery and the predicted changes in bycatch levels would be considered insignificant, although some are shown as conditionally significant in Table 4.5-4.

Table 4.5-2 Criteria used to describe significance of impacts on prohibited species bycatch

Issue	Effect	Significant	Conditionally Significant* (beneficial)	Conditionally Significant* (adverse)	Insignificant	Unknown
Salmon Bycatch	Direct	Substantial difference in bycatch (+->100%) removal	Marginally less (>-50%-99%) bycatch removed by trawl fisheries	Marginally more (>+50%-99%) bycatch removed by trawl fisheries	No substantial difference in bycatch (+-0-50%) removed by trawl fisheries	Insufficient Information Available
Halibut Bycatch	Direct	Substantial difference in bycatch (+->100%) removal	Marginally less (>-50%-99%) bycatch removed by all fisheries	Marginally more (>+50%-99%) bycatch removed by all fisheries	No substantial difference in bycatch (+-0-50%) removed by all fisheries	Insufficient Information Available
Herring Bycatch	Direct	Substantial difference in bycatch (+->100%) removal	Marginally less (>-50%-99%) bycatch removed by trawl fisheries	Marginally more (>+50%-99%) bycatch removed by trawl fisheries	No substantial difference in bycatch (+-0-50%) removed by trawl fisheries	insufficient Information Available
Crab Bycatch	Direct	Substantial difference in bycatch (+->100%) removal	Marginally less (>-50%-99%) bycatch removed by all fisheries	Marginally more (>+50%-99%) bycatch removed by all fisheries	No substantial difference in bycatch (+-0-50%) removed by all fisheries	Insufficient Information Available
Spatial Temporal Concentration of Bycatch	Direct	Substantially more or less concentration of fisheries bycatch	Marginally less concentration of all fisheries bycatch	Marginally more concentration of all fisheries bycatch	Same concentration of fisheries bycatch	Insufficient Information Available
Prey Competition	Indirect	Substantial biomass removal (+/-) of by all fisheries	Marginally less biomass removal of prey by all fisheries	Marginally more biomass removal of prey by all fisheries	No substantial difference in prey biomass removal by all fisheries	Insufficient Information Available

Note: Almost the entire bycatch of herring and salmon are taken in trawl fisheries, whereas the bycatch of crab and halibut are taken by multiple gear types.

*The "Conditionally Significant" category reflects both defined criteria and a level of uncertainty in estimating effects.

Table 4.5-3 Summary of effects of Alternatives 1 through 5 on prohibited species bycatch (pollock and Pacific cod) in the Bering Sea

Species/Species Group	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Halibut	I	I	I	I	I
Herring	I	CS-	I	I	I
Chinook Salmon	I	CS+	I	I	I
Other Salmon	I	CS+	I	I	I
Red King Crab	I	I	I	I	I
Tanner Crab	I	I	I	I	I
Other Tanner Crab	I	I	I	I	I
Other King Crab	I	CS-	I	I	I
Spatial Temporal Concentration of Bycatch - BSAI/All Species	I	I	I	I	I
Prey Competition	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.5-4 Summary of effects of Alternatives 1 through 5 on prohibited species bycatch (Atka mackerel) in the Aleutian Islands.

Species/Species Group	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Halibut	I	I	I	I	I
Herring	I	CS+	CS+	I	I
Chinook Salmon	CS+	CS+	CS-	CS+	CS+
Other Salmon	I	I	I	I	I
Red King Crab	I	I	I	I	I
Tanner Crab	I	I	I	I	I
Other Tanner Crab	I	CS+	CS+	CS+	I
Other King Crab	I	I	I	I	I
Spatial Temporal Concentration of Bycatch - BSAI All Species	I	I	I	I	I
Prey Competition	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.5.2 Gulf of Alaska

Sections 4.5.2.1 - 4.5.2.5 below describing the effects of each alternative on Gulf of Alaska (GOA) Area bycatch will refer to Table 4.5.2-1 which presents the percentage change in bycatch levels expected under each of the alternatives. A description of the data and analysis used in the creation of Table 4.5.2-1 are provided in section 4.5.1 above. The baseline bycatch amounts for herring, other Tanner crab, and red king crab are very small. Since there are no bycatch limits on these species in the GOA, the bycatch is generally low, and was low during the years included in the analysis, the expected effects due to the alternatives for these species will not be discussed. The only species with a prohibited species bycatch limit in the GOA is halibut.

Table 4.5-5 The estimated change in bycatch levels in the GOA when compared to the average estimated from 1997 and 1999.

Pollock Fishery						
Catch of 104,095 Tons Stock	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Baseline Catch
Herring	1%	-31%	-8%	-2%	6%	15
Halibut	0%	51%	3%	8%	13%	37
<i>C. bairdi</i> Crab	4%	-49%	9%	15%	-19%	1,967
Other Tanners	35%	-100%	19%	60%	40%	4
Red King Crab	1%	-100%	19%	20%	31%	11
Chinook Salmon	2%	-49%	11%	6%	14%	20,013
Other Salmon	3%	-45%	12%	-11%	-1%	7,036

Pacific Cod Fishery						
Catch of 72,841 Tons Stock	Alt.1	Alt.2	Alt.3	Alt.4	Alt.5	Baseline Catch
Herring	3%	-92%	45%	17%	2%	0
Halibut	0%	6%	14%	1%	0%	878
<i>C. bairdi</i> Crab	1%	10%	7%	12%	2%	52,517
Other Tanners	-2%	25%	-65%	-49%	1%	1,642
Red king Crab	3%	51%	46%	18%	2%	14
Other King Crab	30%	90%	43%	49%	30%	40
Chinook Salmon	7%	-33%	38%	2%	7%	778
Other Salmon	3%	30%	46%	13%	3%	597

Note: Baseline units for crabs and salmon are in numbers; all other species are in metric tons. Note that other Tanners are mainly *C. opilio* crab, and other salmon are primarily chum salmon.

Source: NMFS catch by vessel database (same as used to prepare Appendix E).

4.5.2.1 Effects of Alternative 1 on Prohibited Species Bycatch in the GOA

As was the case in the BSAO (4.5.1.1), Alternative 1 is the most similar to the fishing conditions in place during the period 1997 - 1999, so that small percentage changes in bycatch levels would be expected. There was no expected change in halibut bycatch under Alternative 1 in either the pollock or Pacific cod fisheries.

Chinook salmon and other salmon had small predicted increases in bycatch (2% and 3%, respectively, in the pollock fishery, and 7% and 3%, respectively, in the Pacific cod fisheries) under this alternative.

Tanner (*C. bairdi*) crab bycatch was expected to increase marginally (1%) under Alternative 1 in the Pacific cod fisheries.

4.5.2.2 Effects of Alternative 21 on Prohibited Species Bycatch in the GOA

Alternative 2 prohibits trawling in the largest amount of area across the five alternatives in the GOA in the pollock fishery. The pollock fishery is prosecuted exclusively with trawl gear, and this alternative predicts the greatest change in bycatch percentages in the pollock trawl fishery.

Halibut bycatch was predicted to increase by 51% in the pollock fishery under Alternative 2. However, the baseline catch amount in this fishery is low (37 mt), and recent changes in the pollock fishery (non-pelagic trawl ban, see 4.5.1 above) would maintain low bycatch levels in this fishery. There was a predicted increase in halibut bycatch of 6% in the Pacific cod fisheries.

Alternative 2 is expected decrease the bycatch of all other species in the pollock fishery. The alternative is expected to reduce chinook salmon bycatch in both the pollock and Pacific cod fisheries (49% and 33%, respectively). Other salmon bycatch was expected to decrease in the pollock fishery by 45% and increase in the Pacific cod fishery by 30%, although the baseline bycatch numbers for this fishery are low.

The bycatch of Tanner (*C. bairdi*) crab would be expected to increase by 10% in the Pacific cod fisheries under this alternative.

4.5.2.3 Effects of Alternative 3 on Prohibited Species Bycatch in the GOA

Alternative 3 closes entire areas to all fisheries, and thus has the highest predicted changes in the Pacific cod fishery bycatch levels (the largest area closure for the pollock fishery was under Alternative 2).

Predictions under Alternative 3 led to expected increases in all bycatch species with the exception of a decrease in Pacific herring bycatch (8%) in the pollock fishery and a decrease in Tanner (*C. bairdi*) crab (65%) in the Pacific cod fisheries.

Based on the historic data, increases of 9%, 11% and 12% were predicted for Tanner crab, chinook salmon, and other salmon, respectively in the pollock fishery. The predicted percentage increases in halibut, chinook salmon, and other salmon bycatch were the highest of any alternative in Alternative 3 for the Pacific cod fisheries. Halibut was expected to increase by 14%, and chinook salmon and other salmon were expected to increase by 38% and 46%, respectively in the Pacific cod fishery under Alternative 3. The increased halibut bycatch would be expected to lead to an earlier closure for one or more of the Pacific cod fisheries, depending on PSC cap levels.

4.5.2.4 Effects of Alternative 4 on Prohibited Species Bycatch in the GOA

Under the complex scenarios of Alternative 4, halibut and chinook salmon bycatch would be expected to increase by 8% and 6%, respectively in the pollock fishery, and other salmon bycatch would be expected to decrease by 11%.

Tanner crab bycatch in the pollock fishery would be expected to increase by 15% were the ban on non-pelagic gear not in effect in the future.

Halibut and chinook salmon bycatch would be relatively unchanged from the baseline under Alternative 4 in the Pacific cod fisheries (1% increase in halibut and 2% increase in chinook salmon bycatch).

Tanner (*C. bairdi*) crab bycatch would be expected to increase by 12% under Alternative 4 in the Pacific cod fisheries, and other salmon bycatch might increase by 13%.

4.5.2.5 Effects of Alternative 5 on Prohibited Species Bycatch in the GOA

Alternative 5 increases the area closed to pollock trawling compared to the baseline years of 1997-1999 by closing areas outside of specified haulouts. This would be expected to increase chinook salmon bycatch by 14% and decrease other salmon bycatch slightly by 1%. The predicted increase in halibut bycatch of 13% would be precluded by the recent ban on non-pelagic trawling.

Alternative 5 is similar in the Pacific cod to the measures in existence when the data was collected. The changes in bycatch levels in the Pacific cod fisheries area marginal.

4.5.2.6 Summary of Effects on Prohibited Species Bycatch in the GOA

An explanation of the criteria used to describe the significance of impacts is summarized in Table 4.5.2.6-1. The significance of the predicted effects of the alternatives on prohibited species bycatch are presented in Table 4.5.2.6-2 for the Gulf of Alaska. .

The bycatch rates for prohibited species in the GOA are low, and the only prohibited species bycatch that is actively managed through caps is that for Pacific halibut. The 2,000 mt trawl halibut mortality cap would trigger fishery closures that would prevent the cap from being exceeded. None of the bycatch levels would be expected to be significant for any prohibited species.

Table 4.5-6 Criteria used to describe significance of impacts on prohibited species bycatch

Issue	Effect	Significant	Conditionally Significant* (beneficial)	Conditionally Significant* (adverse)	Insignificant	Unknown
Salmon Bycatch	Direct	Substantial difference in bycatch (+>100%) removal	Marginally less (>-50%-99%) bycatch removed by trawl fisheries	Marginally more (>+50%-99%) bycatch removed by trawl fisheries	No substantial difference in bycatch (+0-50%) removed by trawl fisheries	Insufficient Information Available
Halibut Bycatch	Direct	Substantial difference in bycatch (+>100%) removal	Marginally less (>-50%-99%) bycatch removed by all fisheries	Marginally more (>+50%-99%) bycatch removed by all fisheries	No substantial difference in bycatch (+0-50%) removed by all fisheries	Insufficient Information Available
Herring Bycatch	Direct	Substantial difference in bycatch (+>100%) removal	Marginally less (>-50%-99%) bycatch removed by trawl fisheries	Marginally more (>+50%-99%) bycatch removed by trawl fisheries	No substantial difference in bycatch (+0-50%) removed by trawl fisheries	insufficient Information Available
Crab Bycatch	Direct	Substantial difference in bycatch (+>100%) removal	Marginally less (>-50%-99%) bycatch removed by all fisheries	Marginally more (>+50%-99%) bycatch removed by all fisheries	No substantial difference in bycatch (+0-50%) removed by all fisheries	Insufficient Information Available
Spatial Temporal Concentration of Bycatch	Direct	Substantially more or less concentration of fisheries bycatch	Marginally less concentration of all fisheries bycatch	Marginally more concentration of all fisheries bycatch	Same concentration of fisheries bycatch	Insufficient Information Available
Prey Competition	Indirect	Substantial biomass removal (+/-) of by all fisheries	Marginally less biomass removal of prey by all fisheries	Marginally more biomass removal of prey by all fisheries	No substantial difference in prey biomass removal by all fisheries	Insufficient Information Available

Note: Almost the entire bycatch of herring and salmon are taken in trawl fisheries, whereas the bycatch of crab and halibut are taken by multiple gear types.

*The "Conditionally Significant" category reflects both defined criteria and a level of uncertainty in estimating effects.

Table 4.5-7 Significance of impacts of the alternatives on prohibited species bycatch in the GOA.

Species/Species Group	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Halibut	I	I	I	I	I
Herring	I	I	I	I	I
Chinook salmon	I	I	I	I	I
Other salmon	I	I	I	I	I
Red king crab	I	I	I	I	I
Tanner crab	I	I	I	I	I
Other tanner crab	I	I	I	I	I
Other king crab	I	I	I	I	I
Spatial Temporal Concentration of Bycatch - BSAI/All Species	I	I	I	I	I
Prey Competition	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.6 Effects on Endangered Species Act Listed Pacific Salmon

Effects of the proposed action alternatives to Endangered Species Act (ESA) listed Pacific salmon could include direct effects of taking ESA listed salmon as bycatch, effects from spatial temporal concentration of that bycatch and indirect effects from removal of prey as bycatch (prey competition). Table 4.6-1 outlines the criteria used to describe the significance of the effects on listed Pacific salmon. Table 4.6-2 summarizes the possible effects for each alternative. No critical habitat for ESA listed salmon occurs in the action area or waters surrounding the action area, so no impact to critical habitat could occur from the proposed action. The pollock midwater trawl fishery was the only fishery considered for bycatch and spatial-temporal bycatch analyses because the majority of chinook, (of which listed salmon would be a subset), are caught in that fishery in both the Bering Sea and Aleutian Islands (BSAI, 92%) and Gulf of Alaska (GOA, 69%) (NMFS, 2001a).

Projected percent differences from an average 1998-1999 baseline catch in numbers of salmon, and 1997-1999 baseline catch in tons of squid (steelhead prey) and herring (chinook prey) for the pollock fishery bycatch are shown by alternative for the BSAI and GOA in Tables 4.6-3 and 4.6-4. These numbers were not calculated for other prey species of salmon, such as forage fish, because no biomass estimates are known. Directed fishing on forage fish by the groundfish fishery is prohibited.

To accurately evaluate the effects of bycatch to listed salmon, significance criteria reflect the overall context of low probability of occurrence of listed salmon encountering the groundfish fishery due to overall low population numbers and low occurrence of fish from natal rivers in Washington and Oregon in bycatch relative to fish from natal rivers in Asia and Alaska.

Spatial temporal concentrations of bycatch were evaluated using the overall spatial distribution showing the characteristics of each alternative and distribution of CWT recoveries for ESA listed chinook salmon

surrogate stocks (Figure 4.6-1) while specifically considering pollock trawl fishing, which accounts for the greatest amount of chinook salmon bycatch. CWT recoveries are concentrated in the waters around Kodiak Island. CWT recovery locations were obtained from observer program coverage of the BSAI and GOA groundfish fisheries and are the best available data to evaluate the possible distribution of ESA listed salmon.. The distribution of CWT recoveries around Kodiak Island were of interest to spatial-temporal considerations and therefore evaluated for each alternative.

Differences for herring and squid were considered relative to overall biomass to evaluate significance of projected changes. The opportunistic nature of salmon feeding ecology was also considered to rate significance. An acceptable biological catch (ABC) for squid is not known for the GOA but in the BSAI the ABC is 1,970 metric tons (Fritz, 2001). Consequently, the baseline squid catches of 695 tons for the BSAI and 26 tons for the GOA are considered small. Herring is a prohibited species in both the BSAI and GOA groundfish fisheries. A catch limit of 1% of stock biomass of herring is set for the BSAI, which should protect herring stocks from groundfish fishery over-exploitation. The BSAI biomass of herring was reported as 152,574 metric tons in December, 2000.¹ A similar biomass estimate for the GOA is not available, however the average extrapolated bycatch in the GOA of 15 tons from 1997-1999 (NMFS observer data, 2000)² is considered small.³

4.6.1 Effects of Alternative 1 on ESA Listed Pacific Salmon

Direct Effect - Bycatch

Alternative 1 would not change the percent bycatch of chinook salmon in the BSAI pollock fishery and would increase by 2 percent the bycatch of chinook salmon in the GOA pollock fishery. Both of these levels are less than a 10-50% change in bycatch levels from baseline . Alternative 1 is therefore given an impact rating of insignificant.

Direct Effect - Spatial Temporal Concentration of Bycatch

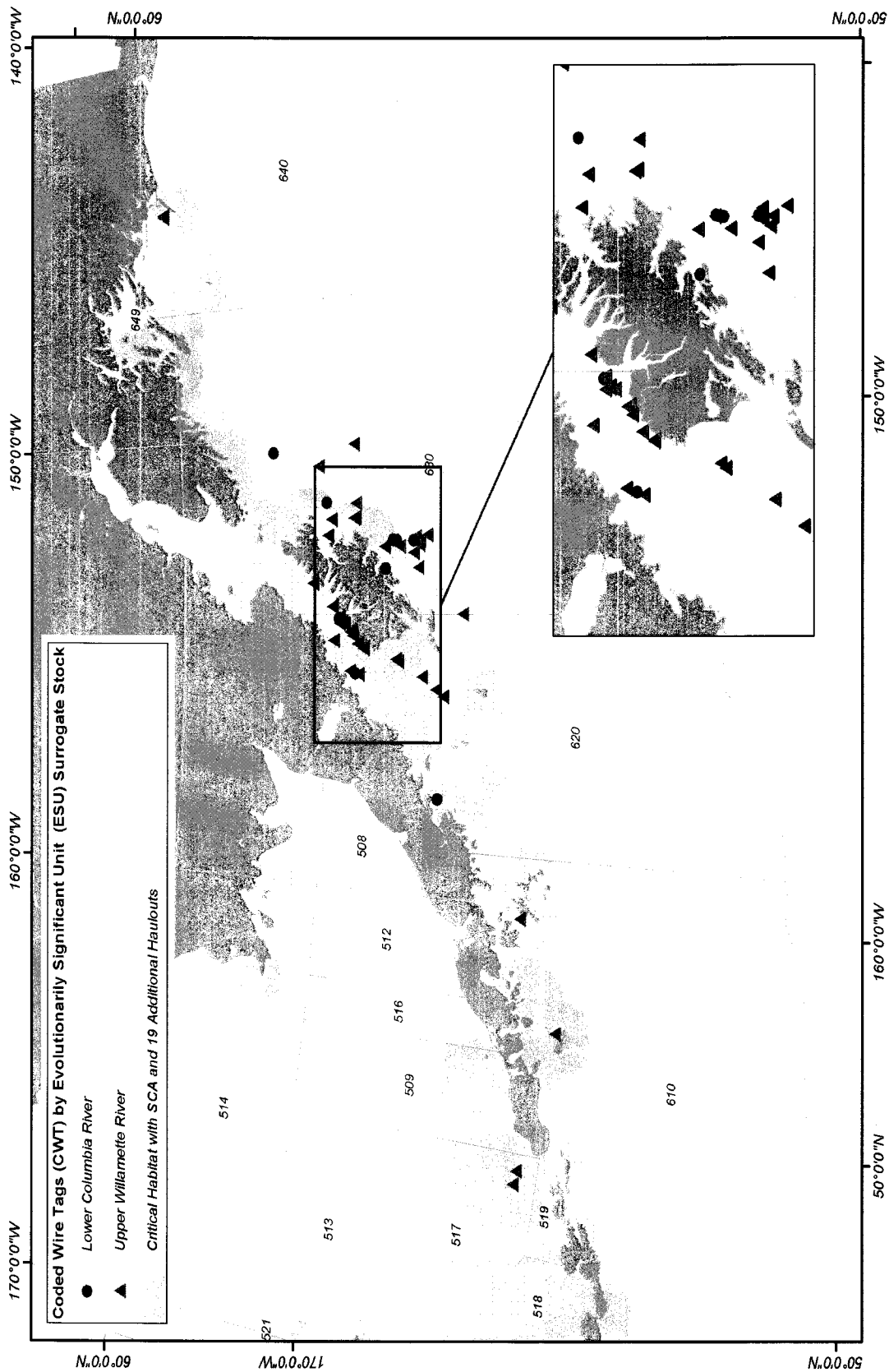
Alternative 1 would include pollock season of January 20 to April 15 and September 1 to November 1. The Catcher Vessel Operation Area (CVOA) (which overlaps SCA) would be closed September 1 to November 1. As reflected in the percent change estimated for bycatch, these spatial temporal effects are not expected to significantly affect listed salmon and therefore Alternative 1 is given an impact rating of insignificant.

¹Fritz Funk, "Personal Communication," Alaska Department of Fish and Game, P.O. Box 25526, Juneau, AK 99802-5526.

²Andrew Smoker, "Personal Communication," NMFS, AK Region, P.O. Box 21668, Juneau, AK 99802.

³Funk, "Personal Communication."

Figure 4.6-1 Coded Wire Tags (CWT) by Evolutionarily Significant Unit (ESU) Surrogate Stock



Indirect Effect - Prey Competition

Alternative 1 would decrease the percent bycatch of squid in the BSAI pollock fishery by 2 percent and not change the percent bycatch of squid in the GOA. Alternative 1 would increase the percent bycatch of herring by 1 percent in both the BSAI and GOA. All of these levels are not expected to substantially affect overall prey biomass and are insignificant to ESA salmon; therefore Alternative 1 is given an impact rating of insignificant.

4.6.2 Effects of Alternative 2 on ESA Listed Pacific Salmon

Direct Effect - Bycatch

Alternative 2 would decrease the bycatch of chinook salmon in the BSAI pollock fishery by 59% and would decrease the bycatch of chinook salmon in the GOA pollock fishery by 49%. Alternative 2 is therefore given an impact rating of conditionally significant (positive) for the BSAI (change of 50-99%) and conditionally significant, positive (change of 0-50%) for the GOA pollock fishery. The 49% was deemed close enough to the criteria threshold of 50% to justify a conservative rating based on the listed status of the species involved.

Direct Effect - Spatial Temporal Concentration of Bycatch Alternative 2 would establish four equal seasons throughout the year for pollock and would prohibit trawling in critical habitat including the SCA and waters around Kodiak. Alternative 2 is given a rating of conditionally significant (positive) for the GOA, but not the BSAI because most CWT recoveries are located in the waters around Kodiak, effort would be spread throughout the year, and the percent differences in projected bycatch was conditionally significant (positive),

Indirect Effect - Prey Competition

Alternative 2 would decrease the percent bycatch of squid in the BSAI by 40% and increase the bycatch of squid in the GOA by 143%. The overall tonnage of squid taken in the GOA is considered small, so an increase of 143% there is insignificant. Alternative 2 would decrease the percent bycatch of herring in the BSAI by 1% and in the GOA by 31%. The overall bycatch of herring in the GOA is considered to be small. Therefore, Alternative 2 is given an impact rating of insignificant.

4.6.3 Effects of Alternative 3 on ESA Listed Pacific Salmon

Direct Effect - Bycatch

Alternative 3 would decrease the bycatch of chinook salmon in the BSAI pollock fishery by 33% and increase the bycatch of chinook salmon in the GOA by 11%. Alternative 3 is therefore given an impact rating of insignificant.

Direct Effect - Spatial Temporal Concentration of Bycatch

Alternative 3 would prohibit trawling from November 1 through January 20, retain winter (A/B) and fall (C/D) seasons and establish four seasons within the open Steller sea lion critical habitat zones. The SCA would be closed to fishing except for area 7 and waters around Kodiak would be closed in area 2, roughly the northern half, but not in area 3, roughly the southern half. Alternative 3 excludes fishing in areas of high salmon bycatch, but not to the same extent as Alternative 2. This is reflected in the percent differences in bycatch and therefore Alternative 3 is given an impact rating of insignificant.

Indirect Effect - Prey Competition

Alternative 3 would decrease the percent bycatch of squid in the BSAI pollock fishery by 50% and would decrease the percent bycatch of squid in the GOA pollock fishery by 31%. Alternative 3 would decrease the percent bycatch of herring in the BSAI pollock fishery by 12% and decrease the percent bycatch of herring in the GOA by 8%. All of these levels are considered insignificant to ESA listed salmon and therefore Alternative 3 is given an impact rating of insignificant.

4.6.4 Effects of Alternative 4 on ESA Listed Pacific Salmon

Direct Effect - Bycatch

Alternative 4 would decrease the bycatch of chinook salmon in the BSAI pollock fishery by 9% and would increase the bycatch of chinook salmon in the GOA pollock fishery by 6%. Alternative 4 is therefore given an impact rating of insignificant.

Spatial Temporal Concentration of Bycatch Alternative 4 establish an A season and B season for pollock in the Bering Sea, from January 20 to June 10, and June 11 to October 31, respectively. Four seasons throughout the year would be established for pollock in the Gulf of Alaska. Area 9 of the SCA would be closed to trawling, but areas 7 and 8 would be open except for a portion restricted in the pollock A season and no CVOA trawling from June 10 to December 31. Areas around Kodiak Steller sea lion haulouts and rookeries would be closed. These changes are considered insignificant to listed salmon and therefore Alternative 4 is given an impact rating of insignificant.

Indirect Effect - Prey Competition

Alternative 4 would decrease the bycatch of squid by 2% in the BSAI pollock fishery and decrease the bycatch of squid in the GOA pollock fishery by 32%. Alternative 4 would increase the bycatch of herring in the BSAI pollock fishery by 16% and would decrease the bycatch of herring in the GOA pollock fishery by 2%. All of these levels are considered insignificant to ESA listed salmon and therefore Alternative 4 is given an impact rating of insignificant.

4.6.5 Effects of Alternative 5 on ESA Listed Pacific Salmon

Direct Effects - Bycatch

Alternative 5 would decrease the bycatch of chinook salmon in the BSAI pollock fishery by 6% and increase the bycatch of chinook salmon in the GOA pollock fishery by 14%. Alternative 5 is therefore given an impact rating of insignificant.

Direct Effect - Spatial Temporal Concentration of Bycatch Alternative 5 would establish four seasons in the Bering Sea pollock fishery and four seasons in the Gulf of Alaska pollock fishery. Portions of SCA areas 7 and 8 would be closed to catcher-processor pollock trawling from June 10 to December 31. These measures are insignificant to listed salmon and therefore Alternative 5 is therefore given an impact rating of insignificant.

Indirect Effect - Prey Competition

Alternative 5 would decrease the bycatch of squid in the BSAI pollock fishery by 20% and decrease the bycatch of squid in the GOA pollock fishery by 4%. Alternative 5 would decrease the bycatch of herring in the BSAI pollock fishery by 9% and increase the bycatch of herring in the GOA pollock fishery by 6%.

All of these levels are considered insignificant to ESA listed salmon and therefore Alternative 5 is given an impact rating of insignificant.

Table 4.6-1 Criteria used to describe significance of impacts on ESA listed Pacific salmon.

Issue	Effect	Significant	Conditionally Significant* (pos)	Conditionally Significant* (neg)	Insignificant	Unknown
Bycatch	Direct	Substantial difference in chinook bycatch (+>100%) removed by pollock trawl fishery.	Marginally less (>-50%-99%) chinook bycatch removed by pollock trawl fishery.	Marginally more (>+50%-99%) chinook bycatch removed by pollock trawl fishery.	No substantial difference in chinook bycatch (+-0-50%) removed by pollock trawl fishery	Insufficient information available
Spatial Temporal Concentration of Bycatch	Direct	Substantially more or less concentration of fishery bycatch in area/time of CWT recoveries	Marginally less concentration of fishery in area/time of CWT recoveries.	Marginally more concentration of fishery in area/time of CWT recoveries	Same concentration of fishery in area/time of CWT recoveries.	Insufficient information available
Prey Competition	Indirect	Substantial biomass removal (+/-) of by fishery	Marginally less biomass removal of prey by fishery	Marginally more biomass removal of prey by fishery	No substantial difference in prey biomass removal by fishery	Insufficient information available

* The "Conditionally Significant" category reflects both defined criteria and an element of uncertainty in rating effects.

Table 4.6-2 Summary of impacts of the alternatives on ESA listed Pacific salmon.

ESA Listed Salmon	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Bycatch - BSAI	I	CS+	I	I	I
Bycatch - GOA	I	CS+	I	I	I
Spatial Temporal Concentration of Bycatch - BSAI	I	I	I	I	I
Spatial Temporal Concentration of Bycatch - GOA	I	CS+	I	I	I
Prey Competition	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.6-3 Percent difference in selected bycatch as compared to baseline catch for Bering Sea and Aleutian Islands Region pollock fishery.

Species	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Baseline Catch
Chinook	0%	-59%	-33%	-9%	-6%	31,007 fish
Squid	-2%	-40%	-50%	-2%	-20%	695 tons
Herring	1%	-1%	-12%	16%	-9%	804 tons

Procedure: compare average baseline catch for 1998-1999 (salmon) or 1997-1999 (herring, squid) using partial extrapolation of observed data. Personal communication David Ackley NMFS, Sustainable Fisheries Division, P.O. Box 21668, Juneau, AK 99802.

Table 4.6-4 Percent difference in selected bycatch as compared to baseline catch for Gulf of Alaska Region pollock fishery.

Species	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Baseline Catch
Chinook	2%	-49%	11%	6%	14%	20,013 fish
Squid	0%	143%	-31%	-32%	-4%	26 tons
Herring	1%	-31%	-8%	-2%	6%	15 tons

Procedure: compare average baseline catch for 1998-1999 (salmon) or 1997-1999 (herring, squid) using partial extrapolation of observed data. Personal communication David Ackley, NMFS, Sustainable Fisheries Division, P.O. Box 21668, Juneau, AK 99802.

4.6.6 Summary of the Effects and Re-initiation of Section 7 Consultation on ESA Listed Pacific Salmon

Effects of the alternatives to ESA listed salmon were evaluated for bycatch, spatial temporal distribution of bycatch and prey competition. For bycatch, the projected differences from a baseline showed some differences between the alternatives. These differences were insignificant except for Alternative 2. Alternative 2 resulted in a conditionally positive effect to ESA listed salmon by decreasing expected bycatch in the pollock fishery by 59% in the BSAI and 49% in the GOA. For the spatial-temporal distribution of bycatch, season and area effects were insignificant except for the GOA in Alternative 2. This is because CWT recoveries were clustered around Kodiak Island and Alternative 2 would prohibit trawling in the waters around Kodiak that overlap with the locations of most CWT recoveries (Figure 4.6-1). For effects to prey of listed salmon, the projected differences from a baseline showed some differences between the alternatives. When considered relative to overall biomass of these species, those differences were insignificant.

Re-initiation of Consultation under Section 7 of the ESA is unnecessary

Effects were evaluated to determine if a need to reinitiate formal consultation, pursuant to Section 7 of the ESA would be necessary as a result of any of the alternatives. None of the alternatives are expected to negatively effect ESA listed salmon by an increase in incidental take or adverse modification of critical habitat. In addition, no new information has become available since or alternative actions modified in a manner not previously considered by the NMFS (2000a) Biological Opinion that would be expected to change the conclusion that no adverse effect to ESA listed salmon will result from any of the alternatives. The only possible effects detected from the alternatives would be positive to ESA listed salmon for Alternative 2. Consequently, re-initiation of ESA Section 7 consultation is not necessary for ESA listed salmon.

4.7 Effects on Seabirds

Impacts of fishery management on seabirds are difficult to predict due to the lack of information for many aspects of seabird ecology. A summary of incomplete and unavailable information was presented in the Draft Programmatic SEIS, (Section 4.3.1) and was followed by a description of the current management regime at that time (Section 4.3.2) and then by an analysis of the effects of the Draft Programmatic SEIS alternatives on seabirds (Section 4.3.3) (NMFS, 2001a).

This seabird analysis was patterned after the Draft Programmatic SEIS analysis on seabirds. The alternatives in this SEIS range from no action, which may allow the potential for competition with fisheries and Steller sea lions for prey resources, to sets of fisheries management measures designed to separate the fisheries from competition with Steller sea lions. Alternatives 3, 4, and 5 take slightly different approaches in providing protection for Steller sea lions. The main difference between each of the alternatives is the types of fisheries allowed inside critical habitat, and where within critical habitat the fisheries would be allowed.

This analysis is organized in three tiers:

- a) The effects on each seabird species/group are discussed separately,
- b) Each alternative is addressed for each species/group,
- c) Each type of effect is addressed for each alternative within each species/group.

Seabird Groups to Consider: Given the information gaps described above, it is not likely that the fishery effects on most individual bird species are discernable. For the following reasons, some individual species are considered. Effects on the northern fulmar are considered because this species accounts for the vast majority of incidental take that occurs in the longline fisheries of the BSAI and GOA and is one of the most abundant species that breeds in Alaska colonies. Due to special management concerns for animals listed under the ESA, the effects of the alternatives on the short-tailed albatross, spectacled eider, and Steller's eider will be considered in this analysis. Except for consideration of critical habitat, the effects on other seabirds such as scoters, long-tailed ducks, and harlequin ducks would be similar to the effects on these two eider species. The other seabird species or species groups with the greatest potential for interactions with Alaskan groundfish fisheries are albatrosses and shearwaters (migratory birds that do not breed in Alaska) and piscivorous seabird species (fish-eating seabirds that do breed in Alaska, including murre, kittiwakes, gulls, rhinoceros auklets, puffins, cormorants, jaegers, terns, guillemots, and murrelets). All other seabird species not listed above, such as storm-petrels, crested auklet, and least auklet, are considered as a separate group. Therefore, the impacts of the alternatives were analyzed on the following seabird species or species groups:

- Northern fulmar
- Short-tailed albatross
- Other albatrosses (Laysan's and black-footed) and shearwaters
- Piscivorous seabird species
- Eiders (spectacled and Steller's)
- Other seabird species

Selection of Effects to Analyze: Section 4.3.3 of the Draft Programmatic SEIS provided rationale for the consideration of the potential fishery effects on certain seabird taxonomic groups (NMFS, 2001a). The direct and indirect fishery effects that may impact some species of seabirds are:

- Direct Effects:
 - Incidental take (in gear and vessel strikes)
- Indirect Effects:
 - Prey (forage fish) abundance and availability
 - Benthic habitat
 - Processing waste and offal
 - Contamination by oil spills
 - Nest predators in islands
 - Plastics ingestion

To the extent that vessel operators are in compliance with all Federal and State laws and policies that regulate the prevention and control of oil spills, fuel transfers, plastics disposals, and introduction of non-native species (i.e., rats), these three effects are expected to be minor. Thus, in the context of other fishery-related effects, the Draft Programmatic SEIS analysis concluded that the effects of fishery-related oil spills, nest predators on islands, and plastics ingestion to be insignificant at the population level for all seabird species, including the short-tailed albatross and the spectacled and Steller's eiders. Based on this same rationale, this SEIS analysis considers the four remaining fishery effects of the alternatives on seabirds: incidental take, prey availability, benthic habitat, and processing waste and offal.

Direct Effects - Incidental take

The effects of incidental take of seabirds (from fishing gear and vessel strikes) are described in Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a). Bird species and species groups take estimates are summarized in Table 4.7-1. Birds are taken incidentally in longline, trawl, and pot gear, although the vast majority of that take occurs in the longline fisheries and is comprised primarily of the following species or species groups: fulmars, gulls, shearwaters, and albatrosses. Therefore, this SEIS analysis of incidental take will therefore focus primarily on the longline fisheries and those species. Criteria for determining significance for the impact from incidental take were developed and applied throughout this section (Table 4.7-2).

As noted in Section 4.3.3.1 of the Draft Programmatic SEIS (NMFS, 2001a), several factors are likely to affect the risk of seabird incidental catch including: fishing effort (number of hooks per year), the distribution of effort by sub-area and season, the abundance and distribution of seabirds in the vicinity of fishing vessels, and the use of seabird deterrents in longline fisheries. The relative importance of these factors has not been fully studied. However, it is reasonable to assume that risk goes up or down, partly as a consequence of fishing effort (measured as total number of hooks) each year. But, if seabird avoidance measures used to prevent birds from accessing baited hooks are effective, then effort levels would probably be less of a critical factor in the probability of a bird getting hooked in that an adequately protected hook would not catch a bird. Seabird bycatch avoidance measures are outlined on page 4.3-8 of the Draft Programmatic SEIS (NMFS, 2001a).

Indirect Effects - Prey (forage fish) abundance and availability

See Section 4.3.3 of the Draft Programmatic SEIS for a complete treatment of the effects of prey abundance and availability on seabirds (NMFS, 2001a). Detailed conclusions or predictions cannot be made because of the limitations of the scientific understanding regarding the complexity of marine ecosystems. However, the present level of understanding suggests that management measures leading to increases in abundance and availability of forage fish or other prey species that different seabirds depend upon could be beneficial to seabird populations. Conversely, management measures that lead to decreases in the abundance or availability of forage fish or other prey species could be detrimental to seabird populations. Localized

depletion of prey species around seabird colonies could be particularly detrimental during the chick-rearing period for breeding seabirds. For instance, recent reductions in kittiwake populations at the Pribilof Islands suggest that declines in the abundance of prey near these islands has had a negative impact on these important constituents of the Bering Sea marine ecosystem. However, because pollock of all ages are mobile, it is unclear how changes in management practices could ensure that adequate supplies of pollock of appropriate size (age) classes are available to meet the needs of central place foragers such as breeding seabirds. In addition to age 0 and age 1 pollock, other prey of importance that declined around the Pribilof Islands were capelin and possibly myctophids. In the GOA, important prey species also included sand lance, capelin and herring, and these species appeared to also have declined (at least in some regions) during the 1970s to 1990s (Anderson and Piatt, 1997; Kuletz et al., 1997). Whether the causes for these declines are due to climatic conditions and/or ecosystem effects related to commercial fishing are unknown (NMFS, 2001a).

Quantitative models could further elucidate the potential population-level impact of fisheries-related seabird mortality, particularly for those seabirds species that are killed in high numbers (e.g. northern fulmar), for abundant species (e.g. sooty shearwater and short-tailed shearwater, Laysan's albatross), and for less abundant species of concern (black-footed albatross).

Indirect Effects - Benthic habitat

See Section 4.3.3.1 of the Draft Programmatic SEIS for treatment of the indirect fishery effect on benthic habitat as utilized by seabirds (NMFS, 2001a). The analysis therein is applicable to all five alternatives being analyzed in this SEIS. In summary, given the foraging ecologies of seabird taxa being considered, it appears that the seabird species most likely to be impacted by any indirect gear effects on the benthos would be diving sea ducks such as eiders and scoters as well as cormorants and guillemots. The primary foods in marine areas for diving sea ducks include bivalves, crustaceans, polychaete worms, and mollusks. In wintering areas, spectacled eiders will dive to depths of 70 m to reach prey. As noted in the Draft Programmatic SEIS (NMFS, 2001a; see sections 3.5.1.5 and 3.5.1.11), cormorants and guillemots have diverse diets that include both small schooling fishes (capelin and sand lance) as well as demersal fish species and crustaceans. Cormorants usually range within 20 km of shore and are capable of diving as deep as 40 m. Guillemots typically forage in coastal waters during the breeding season, within 10 km of the colony and are capable of diving as deep as 45 to 50 m. Scoters are typically nearshore foragers and feed primarily on mollusks and sometimes crustaceans (USFWS, 1999a). Bottom trawl gear has the greatest potential to indirectly affect seabirds via their habitat. Thus, the remainder of this analysis will be limited to the impacts of bottom trawl gear on foraging habitat.

Indirect Effects - Processing waste and offal

The volume of offal and processing wastes probably changes approximate in proportion to the total catch in the fishery. Whereas some bird populations may benefit from the food supply provided by offal and processing waste, the material also acts as an attractant that may lead to increased incidental take of some seabird species. Many seabird species around the world have been documented to benefit from fishery discards and processing waste as a supplemental food source (Tasker et al, 2000; Phillips et al, 1999; Furness et al, 1992; James et al, 2000). An analysis that examined discards and fish processing offal from the commercial fisheries in the BSAI and GOA and population trends of animals that might be scavengers (including seabirds) found that there appeared to be no relationship between offal and discard production and bird population trends (Queirolo et al, 1995). Additional research and analysis is needed to ascertain how much benefit seabirds of the North Pacific derive from discards and offal. This information must then be balanced with the adverse impacts associated with the incidental take of seabirds in fishing gear as a result of vessels attracting birds via the processing wastes and offal that are discharged. Any benefit from a

supplemental feeding source could be reduced by the bycatch effects associated with the fishery. TAC level reductions and area restrictions under various alternatives could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact would need to be considered in the balance of the beneficial and detrimental impacts of the disposal actions.

Criteria used to determine significance of effects on seabirds

Significance is determined by considering the context in which the action will occur and the intensity of the action. Typically, the more sensitive the context, i.e. resource, the less intense an impact needs to be in order to be considered significant. A useful tool for determining significance is the concept of 'threshold of significance'. This threshold is the line above which an impact is considered significant and below which it is not. The significance of an effect on seabirds can be beneficial (positive), adverse (negative), or it can be considered conditional. Conditional significance applies in those instances where complete information is not available to reach a strong conclusion regarding potential impacts, but given certain assumptions a 'conditional' conclusion can be reached. In those instances where truly not enough information exists to reach a conclusion, even with assumptions, the term 'unknown effect' is used. Table 4.7-2 outlines the qualitative significance criteria or thresholds that are used for determining if an effect has the potential to create a significant impact on seabirds.

Table 4.7-1. Estimated total incidental catch of seabirds by species or species groups in Bering Sea and Aleutian Islands and Gulf of Alaska longline fisheries, 1993-1999. Values in parentheses are 95% confidence bounds.

Year	Actual Number Taken *	STAL	BFAL	LAAL	NFUL	Gull	SHWR	Unid. Tubenos es	Alcid	Other	Unid. ALB	Unid. Seabird	Total
Bering Sea and Aleutian Islands													
1993	1,942	0	11 (4-21)	617 (458-777)	4,251 (3416-5103)	853 (576-1130)	64 (22-107)	0	15 (4-30)	4 (1-10)	352 (188-517)	1,799 (1399-2200)	7,975 (6981-8968)
1994	2,700	0	37 (7-66)	311 (218-404)	4,826 (4185-5467)	1,734 (1297-2172)	675 (487-864)	350 (226-475)	4 (1-13)	4 (1-11)	76 (43-109)	2,615 (1956-3274)	10,633 (9604-11662)
1995	4,832	0	66 (26-107)	463 (267-660)	9,628 (8613-10643)	3,954 (3274-4634)	330 (225-434)	475 (253-697)	4 (1-11)	45 (16-74)	38 (19-57)	4,211 (3489-4933)	19,214 (17853-20576)
1996	2,002	4 (1-13)	20 (5-48)	234 (156-313)	5,636 (4817-6455)	1,487 (1232-1741)	487 (246-728)	14 (4-26)	46 (9-103)	49 (13-86)	60 (31-90)	442 (326-558)	8,480 (7594-9366)
1997	4,123	0	9 (2-22)	343 (252-433)	13,611 (12109-15122)	2,755 (2276-3234)	300 (154-445)	173 (103-243)	0	7 (2-16)	14 (3-28)	852 (519-1185)	18,063 (16491-19634)
1998	5,851	8 (2-15)	9 (2-21)	1,431 (1068-1734)	15,533 (13873-17192)	4,413 (3732-5093)	1,131 (936-1326)	21 (5-38)	53 (24-82)	48 (15-81)	4 (1-11)	1,941 (1584-2297)	24,592 (22769-26415)
1999	3,293	0	18 (4-34)	573 (475-675)	7,843 (6477-9209)	2,208 (1816-2600)	449 (358-540)	409 (144-673)	4 (1-10)	47 (12-85)	0	859 (551-1167)	12,409 (10940-13877)
Average Annual Estimate													
1993-1996		1 (0-4)	33 (18-48)	406 (336-477)	6,087 (5667-6508)	2,007 (1784-2230)	389 (307-471)	210 (146-274)	17 (3-33)	26 (13-38)	132 (89-175)	2,267 (2001-2533)	11,576 (11034-12117)
1997-1999		3 (0-6)	12 (4-20)	782 (653-912)	12,329 (11455-13203)	3,125 (2818-3432)	626 (540-713)	201 (109-293)	19 (9-29)	34 (17-51)	6 (1-12)	1,217 (1025-1410)	18,352 (17414-19294)
1993-1999		2 (0-4)	24 (15-34)	568 (499-636)	8,762 (8317-9207)	2,486 (2303-2670)	491 (431-551)	206 (152-260)	18 (8-28)	29 (19-40)	78 (53-103)	1,817 (1644-1940)	14,481 (13973-14989)

Table 4.7-1 con't. Estimated total incidental catch of seabirds by species or species groups in Bering Sea and Aleutian Islands and Gulf of Alaska longline fisheries, 1993-1999. Values in parentheses are 95% confidence bounds.

Year	Actual Number Taken *	STAL	BFAL	LAAL	NFUL	Gull	SHWR	Unid. Tuber oses	Alcid	Other	Unid. ALB	Unid. Seabird	Total
Gulf of Alaska													
1993	318	0	29 (9-50)	125 (62-187)	833 (615-1052)	45 (12-77)	59 (18-99)	0	0	3 (1-7)	3 (1-9)	213 (107-318)	1,309 (1056-1563)
1994	126	0	7 (2-16)	169 (89-250)	258 (165-351)	30 (2-81)	26 (5-54)	0	0	0	8 (2-18)	33 (8-66)	532 (397-668)
1995	374	0	236 (169-304)	67 (35-99)	520 (348-692)	99 (53-145)	39 (9-69)	6 (1-16)	0	3 (2-6)	376 (275-476)	173 (105-240)	1,519 (1302-1736)
1996	250	0	658 (455-860)	154 (90-128)	665 (349-982)	121 (6-317)	14 (2-35)	0	0	0	0	19 (3-42)	1,631 (1203-2059)
1997	74	0	99 (32-167)	40 (5-109)	307 (164-451)	46 (14-79)	9 (2-21)	0	0	0	0	12 (2-30)	514 (338-689)
1998	184	0	289 (25-596)	217 (56-378)	919 (308-1530)	53 (14-92)	13 (3-30)	0	0	0	4 (1-12)	0	1,495 (792-2198)
1999	159	0	183 (70-297)	202 (123-280)	277 (156-399)	358 (136-581)	50 (8-93)	0	0	7 (1-21)	0	16 (4-37)	1,093 (812-1375)
Average Annual Estimate													
1993-1996		0	233 (179-287)	129 (97-160)	569 (461-677)	74 (21-127)	35 (19-50)	1 (0-4)	0	1 (0-3)	97 (71-122)	109 (76-142)	1,248 (1108-1388)
1997-1999		0	191 (79-302)	153 (89-217)	501 (288-715)	153 (76-229)	24 (8-40)	0	0	2 (0-7)	1 (0-4)	9 (1-19)	1,034 (775-1293)
1993-1999		0	215 (158-272)	139 (106-172)	540 (429-651)	107 (63-152)	30 (19-41)	1 (0-3)	0	2 (0-4)	56 (41-71)	66 (47-86)	1,156 (1019-1293)

Notes: Species or species group codes. STAL – Short-tailed albatross, LAAL – Laysan albatross, BFAL – Black-footed albatross, NFUL – Northern fulmar, Gull – Unidentified gulls (herring gulls, glaucous gulls, glaucous-winged gulls), SHWR – Unidentified shearwaters (unidentified dark shearwaters, sooty shearwaters, short-tailed shearwaters), Unidentified Tubenose – Unidentified procellariiformes (albatrosses, shearwaters, petrels), Alcid – Unidentified alcids (guillemots, murres, puffins, murrelets, auklets), Other – Miscellaneous birds (could include loons, grebes, storm-petrels, cormorants, waterfowl, eiders, shorebirds, phalaropes, jaeger/skuas, red-legged kittiwakes, black-legged kittiwakes, terns), Unidentified ALB – Unidentified albatrosses (could include short-tailed albatrosses, Layson's albatrosses, black-footed albatrosses)

*Actual number taken is the total number of seabirds recorded dead in the observed hauls.

Spectacled eider, Steller's eider, marbled murrelet, red-legged kittiwake, and Kittlitz's murrelet were not reported by observers in any observed sample from 1993 to 1999. Although of these birds only the 2 eider species are listed under ESA in the action area, USFWS identifies the other 3 species as 'species of concern' because of low and/or declining population levels. 'Species of concern' is an informal classification by the USFWS, Office of Migratory Bird Management. Inclusion on the 'species of concern' list has no regulatory implications.

Source: (NPFMC 2001, SAFE, Ecosystem Considerations for 2002).

Table 4.7-2 Criteria used to determine significance of effects on seabirds.

Effects	Rating				
	Significant (negative)	Conditionally Significant (positive)	Insignificant	Conditionally Significant (negative)	Unknown
Incidental take	Take number and/or rate increases substantially and impacts at the population or colony level.	Take number and/or rate may decrease minimally.	Take number and/or rate is the same.	Take number and/or rate may increase minimally.	Take number and/or rate is not known.
Prey (forage fish) availability	Prey availability is substantially reduced and causes impacts at the population or colony level.	Prey availability may be minimally increased.	Prey availability is the same.	Prey availability may minimally decrease.	Changes to prey availability are not known.
Benthic habitat	Impact to benthic habitat is substantially increased and impacts at the population or within critical habitat.	Impact to benthic habitat may be minimally decreased.	Impact to benthic habitat is the same.	Impact to benthic habitat may be minimally increased.	Impact to benthic habitat is not known.
Processing waste and offal	Availability of processing wastes is substantially decreased and impacts at the population or colony level.	Availability of processing wastes may be minimally increased.	Availability of processing wastes is the same.	Availability of processing wastes may be minimally decreased.	Changes in availability of processing wastes is not known.

4.7.1 Effects on Northern Fulmar

Although northern fulmars breed throughout the Aleutian Islands and many other coastal areas of Alaska, over 90% of the Alaskan breeding population can be found on four main colonies: Semidi Islands (GOA), Chagulak Islands (eastern AI), Pribilof Islands (primarily St. George), and St. Matthew/Hall Islands. These four colony locations also account for the vast majority of other breeding seabird populations as well.

In general, the majority of breeding piscivorous seabirds forage within 40 to 60 km of their colonies, particularly during the chick-rearing phase.¹ Northern fulmars are an exception in that during the incubation period in particular, they are known to forage out to 100 km and more.²

4.7.1.1 Effects of Alternative 1 on Northern Fulmar

Direct Effects - Incidental take

The Draft Programmatic SEIS (NMFS, 2001a) concluded that northern fulmars were the only species showing a positive linear relationship between fishing effort and numbers of birds hooked. This relationship did not exist for other bird groups (albatrosses, gulls, shearwaters).

The population of fulmars on the Pribilof Islands (St. George and St. Paul) was estimated at about 70,000 individuals in the 1970's³. The population on St. George peaked in 1992, followed by nearly an 80% decline over the succeeding two censuses in 1996 and 1999 (Dragoo et al, 2000). It is too early to determine whether the apparent drop in numbers is real. It is possible that the highly variable numbers at the colony in recent years are related to variable environmental conditions during the summer months. But, if a majority of the fulmars taken annually in the longline fishery originate from one colony (such as St. George), and if a substantial proportion of the catch consists of adult birds, then it is possible that fishery bycatch could be contributing to recent declines observed at St. George. Conversely, if the count on St. George in 1992 was anomalously high, the apparent subsequent 'decline' is relatively meaningless in terms of actual population impacts. Fulmars would not be expected to double their numbers over 4 years (i.e., between 1988 and 1992, as suggested by Dragoo et al, 2000), which lends support to that interpretation. A planned pilot study by U.S. Geological Survey (USGS) will collect data on the at-sea foraging distribution of northern fulmars as well as identifying the colony of provenance of a sample of bycaught northern fulmars. Results will be used in the development of population models that may elucidate the potential for incidental take in longline fisheries to have colony-level population impacts.

Alternative 1 is not expected to alter prosecution of the longline fisheries in ways that would further impact the potential for the incidental take of seabirds. Given the above discussion, the effect of incidental take on northern fulmars at the GOA colonies is probably insignificant. Until further information is available, the impact of the incidental take on BSAI fulmar colonies is unknown (Table 4.7-3). The incidental take of fulmars in the BSAI could have potentially have adverse affects at a population and/or colony level if the bycatch is predominantly coming from St. George and if a substantial proportion of the bycaught birds are adults.

Indirect Effects - Prey (forage fish) abundance and availability

Given the increasing population trends at most colonies, northern fulmars do not appear to be prey-limited. Additionally, the ability to forage over extremely vast areas makes these birds unlikely candidates for food availability impacts. The Draft Programmatic SEIS concluded that the impact of Alternative 1 on the

¹K. Kuletz, "Personal Communication," USFWS, 1011 E. Tudor Rd., Anchorage, AK 99501.

²S. Hatch, "Personal Communication."

³S. Hatch, "Personal Communication," USGS, Alaska Biological Science Center, 1011 E. Tudor, Anchorage, AK 99501.

abundance and availability of forage fish was considered insignificant for populations of northern fulmars (NMFS, 2001a).

Indirect Effects - Benthic habitat

Since fulmars are not benthic feeders, the impact of Alternative 1 on fulmars through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

Whereas some bird populations may benefit from the food supply provided by offal and processing waste, it also acts as an attractant that may lead to increased incidental take of some seabird species. Research and analysis is needed to ascertain how much benefit seabirds of the North Pacific derive from discards and offal and to then balance that with the adverse impacts of the associated incidental take. It could be that the northern fulmar, a species known to benefit from fishery discards in the North Atlantic, experiences a similar benefit from North Pacific fisheries. Although fulmars are the most frequently taken species in the groundfish fisheries, they are also the most populous of breeding seabird species in Alaska and exhibit a stable or overall increasing population trend. Given the unknown effect of incidental take on northern fulmars in the BSAI (Table 4.7-3) and on the Pribilof Island colonies in particular, any benefit from a supplemental feeding source could be reduced by the bycatch effects associated with the fishery. Based on this information, the availability of fishery processing wastes could have a conditionally significant beneficial effect on northern fulmars under Alternative 1 (Table 4.7-3).

4.7.1.2 Effects of Alternative 2 on Northern Fulmar

Direct Effects - Incidental take

BSAI cod TAC level reductions under Alternative 2 are projected to substantially reduce the fishing effort (Table 4.2-7). Given these substantial harvest reductions, associated reductions in the incidental catch levels of seabirds that are more typically taken in the BSAI (fulmars, gulls, albatrosses, shearwaters) are expected. Given the current levels of incidental take and the existing measures in place to reduce incidental take of seabirds, it is conceivable that TAC reductions in the BSAI cod fishery would subsequently further reduce levels of seabird incidental take to such levels that the overall impact on fulmars would be lessened. Thus, alternative 2 would have an insignificant impact on fulmars through incidental take (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 2 are considered insignificant at the population level for northern fulmar (Table 4.7-3).

Indirect Effects - Benthic habitat

Since fulmars are not benthic feeders, the impact of Alternative 2 on fulmars through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact should be considered in light of the potential beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and

overall could be considered insignificant at the population level for all seabird species, including northern fulmar (Table 4.7-3).

4.7.1.3 Effects of Alternative 3 on Northern Fulmar

Direct Effects - Incidental take

Except for the Chagulak Island colony, three of the four major fulmar colonies occur within closed areas under Alternative 3 (see Figure 2.3-3 for Alternative 3 measures; see Figures 4.7-1 and 4.7-2 for seabird colonies). Potentially, the overlap between longline vessels and fulmars foraging near colonies would be reduced and could result in reduced levels of interaction and incidental take of fulmars. Given the current levels of incidental take, the existing measures in place to reduce incidental take of seabirds, and all of the above considerations, Alternative 3 is likely to have an unknown effect on fulmars at the BSAI colonies (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 3 are considered insignificant at the population level for northern fulmar (Table 4.7-3).

Indirect Effects - Benthic habitat

Since fulmars are not benthic feeders, the impact of Alternative 3 on fulmars through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

Based on the discussion in Section 4.7.1.1, the availability of fishery processing wastes could have a conditionally significant beneficial effect on northern fulmars under Alternative 3 (Table 4.7-3).

4.7.1.4 Effects of Alternative 4 on Northern Fulmar

Direct Effects - Incidental take

The proposed closures under Alternative 4 of the Seguam foraging area for Steller sea lions and critical habitat east of 173° West to the western boundary of Area 9 could result in the reduced incidental take of northern fulmars in the longline cod fishery. One of the four main colonies of northern fulmars occurs on Chagulak Island in the Seguam Pass area (see Figure 4.7-1 for the seabird colonies). These potential reductions in incidental take would only be realized to the extent that longlining effort occurred in these areas prior to the proposed closures.

Given the current levels of incidental take, the existing measures in place to reduce incidental take of seabirds, and all of the above considerations, Alternative 4 is likely to have an unknown effect on fulmars in the BSAI. See Section 4.7.1.1 for the analysis of the effect of incidental take on fulmars in the BSAI. Until further information is available, the impact of the incidental take on BSAI fulmar colonies is unknown (Table 4.7-3). The incidental take of fulmars in the BSAI could potentially have adverse effects at a population and/or colony level if the bycatch is predominantly coming from St. George and if a substantial proportion of the bycaught birds are adults.

Indirect Effects - Prey (forage fish) abundance and availability

Numerous area closures are proposed under Alternative 4 and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects to some seabirds in some areas during the breeding season. For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 4 are considered insignificant at the population level for northern fulmar (Table 4.7-3).

Indirect Effects - Benthic habitat

Since fulmars are not benthic feeders, the impact of Alternative 4 on fulmars through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

Based on the assumptions noted in Section 4.7.1.1, the availability of fishery processing wastes could have a conditionally significant beneficial effect on northern fulmars under Alternative 4 (Table 4.7-3).

4.7.1.5 Effects of Alternative 5 on Northern Fulmar

Direct Effects - Incidental take

The effects of Alternative 5 with respect to incidental take are expected to be similar to the effects of Alternative 1. Alternative 5 would have unknown effects on fulmars. See Section 4.7.1.1.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 5 are considered insignificant at the population level for northern fulmar (Table 4.7-3).

Indirect Effects - Benthic habitat

Since fulmars are not benthic feeders, the impact of Alternative 5 on fulmars through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

Based on the assumptions noted in Section 4.7.1.1, the availability of fishery processing wastes could have a conditionally significant beneficial effect on northern fulmars under Alternative 5 (Table 4.7-3).

4.7.2 Effects on Short-tailed Albatross

The short-tailed albatross is listed as an endangered species under the Endangered Species Act (ESA). The history of ESA section 7 consultations and NMFS actions carried out as a result of those consultations are described in section 2.95 of the Draft Programmatic SEIS (NMFS, 2001a). Their life history, population biology, and foraging ecology are described in section 3.5.1.3 of that document. Based on new information from site visits to the two known breeding colonies of the short-tailed albatross, the current world total population is estimated at 1500 individuals - 200 birds at Minami-kojima in the Senakaku Islands and 1300 birds at Torishima Island, both islands in Japan.

4.7.2.1 Effects of Alternative 1 on Short-tailed Albatross

Direct Effects - Incidental take

Based on 1993 to 1999 data, it has been recently estimated that two short-tailed albatross are probably taken in the BSAI longline fisheries every year and none in the GOA longline fisheries (Table 4.7-1) or in the trawl fisheries in the BSAI and GOA. At the current population level and the continuing 7-8% annual growth rate, the level of mortality resulting from longline fisheries is not thought to represent a threat to the species' continued survival, although it likely is slowing the recovery (NMFS, 2001a).

Because of its critically small population size, the longline mortality of short-tailed albatrosses is a conservation concern. The expected result of longline fishing activity in 1999 and 2000 was the continuation of a lower population growth rate than that which would have occurred in the absence of fishery related mortality. Two individual albatrosses per year at a population level of approximately 1,100 birds represented a 0.2% decrease in population growth rate (USFWS, 1999). In consideration of this fishery-related mortality, USFWS recently noted that in the event of a major population decline resulting from a natural environmental catastrophe (such as a volcanic eruption on Torishima) or an oil spill, the effects of longline fisheries on short-tailed albatrosses could be significant under ESA (USFWS, 2000). If such a catastrophic event were to occur, it would constitute new information requiring the reinitiation of a Section 7 consultation under the ESA. As noted previously, Alternative 1 (No Action) already includes management measures intended to reduce the incidental catch of short-tailed albatross. Research has been conducted by the Washington Sea Grant Program and recommendations will soon be made for the purpose of revising and improving the current seabird avoidance measures. Estimates are not available of how effective the current measures are, other than to consider the bird catch rates or numbers taken, and it is not evident at this time if the annual and area variation is related to use of the measures (first required in 1997) or to other factors. Current measures, as they continue to be developed and improved, are expected to further reduce the likelihood of adverse effects on short-tailed albatross. Given all of these factors, Alternative 1 is determined to have conditionally significant adverse effects on the short-tailed albatross with respect to incidental take.

Indirect Effects - Prey (forage fish) abundance and availability

Due to increasing population trends, short-tailed albatross do not appear to be prey-limited. Additionally, the ability to forage over extremely vast areas make them unlikely candidates for food availability impacts. For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 1 are considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

Indirect Effects - Benthic habitat

Since short-tailed albatross are not benthic feeders, the impact of Alternative 1 on short-tailed albatross through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

4.7.2.2 Effects of Alternative 2 on Short-tailed Albatross

Direct Effects - Incidental take

Numerous observations have been made of short-tailed albatross in waters around the Aleutian Islands. Overlap occurs between the 10 and 20 nautical miles closures to vessels fishing for cod and observation points for short-tailed albatross (see Figures 4.7-3 and 4.7-4). Thus we can expect that the likelihood of longline vessels interacting with short-tailed albatross would be reduced under Alternative 2 given that vessels are excluded from these areas where the albatross are known to occur. This is somewhat confounded though, in that the observations are mostly reported from commercial fishing vessels. When the vessels move to other areas, the short-tailed albatross may follow. With some exceptions, more of the short-tailed albatross observations in the GOA occurred in offshore areas (Figure 4.7-4). The Alaska Biological Science Center of the USGS and the USFWS are beginning on a joint project to compile all available data sets on the pelagic (at-sea) distribution of seabirds in Alaska and elsewhere in the North Pacific. Such data on the pelagic distribution and abundance of seabirds is critical for addressing questions such as raised in this analysis on seabirds and could be used to assess the potential interactions between commercial fisheries and seabirds (e.g. longlines and albatrosses) ⁴.

Since 1993 when observers have collected comprehensive seabird bycatch data, most of the reported short-tailed albatross takes have occurred during September and October (NMFS, 2001a). An abundance index for short-tailed albatross in waters off Alaska indicates that August (highest index), July, and June experience the highest abundance (USFWS, 1999b). If under Alternative 2 The BSAI cod fishery was prosecuted during the June 15 to August 15 quarter, it is possible that vessels would potentially interact more frequently with short-tailed albatross. Given all of these factors, Alternative 2 was determined to have conditionally significant adverse effects on the short-tailed albatross with respect to incidental take.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in section 4.7.2.1 above, the potential indirect fishery effects on prey abundance and availability of Alternative 2 are considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

Indirect Effects - Benthic habitat

Since short-tailed albatross are not benthic feeders, the impact of Alternative 2 on short-tailed albatross through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact would need to be considered in light of the balance between the beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all seabird species, including short-tailed albatross (Table 4.7-3).

⁴J. Piatt, "Personal Communication," USGS, Alaska Biological Science Center, 1011 E. Tudor Rd., Anchorage, AK 99501.

4.7.2.3 Effects of Alternative 3 on Short-tailed Albatross

Direct Effects - Incidental take

The overlap of short-tailed albatross observations with areas closed to longlining is greater in the BSAI than in the GOA under Alternative 3 and is greater under Alternative 2 than under Alternative 3 (see Figure 2.3-3 for Alternative 3 measures; see Figures 4.7-3 and 4.7-4 for short-tailed albatross observations). As discussed previously, it is possible that the likelihood of longline vessels interacting with short-tailed albatross would be reduced given that vessels are excluded from these areas where the albatross are known to occur. Following the rationale outlined in sections 4.7.2.1 and 4.4.2.2, Alternative 3 was determined to have conditionally significant adverse effects on the short-tailed albatross with respect to incidental take.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in section 4.7.2.1 above, the potential indirect fishery effects on prey abundance and availability of Alternative 3 are considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

Indirect Effects - Benthic habitat

Since short-tailed albatross are not benthic feeders, the impact of Alternative 3 on short-tailed albatross through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

4.7.2.4 Effects of Alternative 4 on Short-tailed Albatross

Direct Effects - Incidental take

The proposed closures under Alternative 4 of the Seguam foraging area for Steller sea lions and critical habitat east of 173° West to the western boundary of Area 9 could result in the reduced incidental take of short-tailed albatrosses in the longline cod fishery. Short-tailed albatross have been observed in that area (see Figure 2.3-5 for Alternative 4 measures; see Figure 4.7-3 for short-tailed albatross observations). These potential reductions in incidental take would only be realized to the extent that longlining effort occurred in these areas prior to the proposed closures.

The seasonal TAC apportionments to the longline cod fisheries in the BSAI [January 1 - June 10 (60%), June 10 - December 31 (40%)] and GOA (A-season = 60% of TAC: January 1, B-season = 40% of TAC: September 1) could result in longline cod fishing that avoids the high abundance indexes for short-tailed albatrosses. Since 1993 when observers have collected comprehensive seabird bycatch data, most of the reported short-tailed albatross takes have occurred in September and October (NMFS, 2001a). An abundance index for short-tailed albatross in waters off Alaska indicates that August (highest index), July, and June experience the highest abundance (USFWS, 1999b). If under Alternative 4 the BSAI cod fishery was prosecuted during times of lower short-tailed albatross abundance, it is possible that vessels would potentially interact less frequently with short-tailed albatross.

It is not known to what extent the proposed small boat exemptions for fixed gear under Option 1 and Option 2 could affect the incidental catch of short-tailed albatross and other seabirds. Vessels under 60 ft LOA are not required to carry observers thus observer data on seabird bycatch is not available.

Following the rationale outlined in sections 4.7.2.1 and 4.4.2.2, Alternative 4 was determined to have conditionally significant adverse effects on the short-tailed albatross with respect to incidental take.

Indirect Effects - Prey (forage fish) abundance and availability

Numerous area closures are proposed under Alternative 4 and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects to some seabirds in some areas during the breeding season. For the reasons noted in section 4.7.2.1 above, the potential indirect fishery effects on prey abundance and availability of Alternative 4 are considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

Indirect Effects - Benthic habitat

Since short-tailed albatross are not benthic feeders, the impact of Alternative 4 on short-tailed albatross through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

4.7.2.5 Effects of Alternative 5 on Short-tailed Albatross

Direct Effects - Incidental take

The effects of Alternative 5 with respect to incidental take are expected to be similar to the effects of Alternative 1 (Section 4.7.1.1). Alternative 5 could have conditionally significant adverse effects on the short-tailed albatross.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in section 4.7.2.1 above, the potential indirect fishery effects on prey abundance and availability of Alternative 5 are considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

Indirect Effects - Benthic habitat

Since short-tailed albatross are not benthic feeders, the impact of Alternative 5 on short-tailed albatross through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for short-tailed albatross (Table 4.7-3).

4.7.3 Effects on Other Albatrosses and Shearwaters

Although not an ESA-listed species, the black-footed albatross is of some concern because some of the major colony population counts may be decreasing or of unknown status. The current world population is estimated at 300,000 (NMFS, 2001e). This species is classified as 'vulnerable' under the international classification criteria of the World Conservation Union (IUCN).

Although not an ESA-listed species, the black-footed albatross is of some concern because some of the major colony population counts may be decreasing or of unknown status. The current world population is estimated

at 300,000 (NMFS, 2001e). This species is classified as 'vulnerable' under the international classification criteria of the World Conservation Union (IUCN). The Laysan's albatross is the most numerous of the North Pacific albatrosses, with a worldwide population of approximately 2.5 to 3 million birds (Gales 1998). Given the relative abundance of this species compared to other albatross species, its status is generally considered to be relatively secure. However, of the 16 documented breeding sites, two populations, representing 93 percent of the total breeding stock, are known to be decreasing (Gales 1998). Both shearwater species breed in the Southern Hemisphere and visit Alaska in their non-breeding season, May through September. There is building evidence that shearwater populations are decreasing worldwide but the mechanism(s) for these declines have yet to be elucidated (NMFS, 2001a). The populations of shearwaters in Alaskan waters in summer account for over 50 percent of all seabirds combined (Sanger and Ainley, 1988).

4.7.3.1 Effects of Alternative 1 on Other Albatrosses and Shearwaters

Direct Effects - Incidental take

The combined annual estimated take of black-footed albatrosses in the BSAI and GOA groundfish longline fisheries is 385 birds (Table 4.7-1). This level alone is an insignificant impact to the black-footed albatross population. But mortality also occurs in the Hawaiian pelagic longline fisheries and may be assumed to occur in other North Pacific longline fisheries conducted by Japan, Taiwan, Korea, Russia, and China. Based on 1994 through 1999 data, the estimated average annual total catch of black-footed albatrosses in the Hawaiian pelagic longline fishery is 1,743 (NMFS, 2001e). Thus, approximately 2,100 birds are estimated to be taken annually in the Hawaii and Alaska longline fisheries. Preliminary annual estimates of numbers of both black-footed and Laysan's albatrosses taken in non-U.S. fisheries in the North and Central Pacific pelagic longline fisheries (swordfish and tuna) are about 30,000 birds (Cousins et al, 2001). It is not known what portion of these are black-footed albatrosses. Preliminary conclusions from population modeling indicate that a loss of 10,000 birds per year (natural and anthropogenic mortality sources) is about the maximum a population of 300,000 black-footed albatrosses could sustain and still remain stable (Cousins and Cooper, 2000). Further, the modeling exercises indicated that if the total number of birds killed in the longline fishery each year is 1% of the total population, then the population growth rate will be reduced by more than 1% (Cousins, 2001). Thus, taken together, it is possible that even though the bycatch from the BSAI and GOA groundfish longline fisheries accounts for a very small portion of the total that is estimated to potentially occur in the North and Central Pacific fisheries, it could contribute to a significant cumulative effect on the black-footed albatross. For this reason, with respect to incidental take, Alternative 1 (and the other 4 alternatives) is determined to have conditionally significant adverse effects on the black-footed albatross at the colony or population level. The impact on other albatross and shearwater species is determined to be insignificant.

Indirect Effects - Prey (forage fish) abundance and availability

Due to their ability to forage over extremely vast areas and migratory habits, albatross and shearwater are unlikely candidates for food availability impacts. For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 1 are considered insignificant at the population level for all albatross and shearwater species (Table 4.7-3).

Indirect Effects - Benthic habitat

Since these species are not benthic feeders, the impact of Alternative 1 on other albatross and shearwater species through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for albatross and shearwater species (Table 4.7-3).

4.7.3.2 Effects of Alternative 2 on Other Albatrosses and Shearwaters

Direct Effects - Incidental take

The impacts of Alternative 2 on other Albatrosses and Shearwaters through incidental take is similar to the discussion of impacts on short-tailed albatross in section 4.7.2.2. See also the discussion above in section 4.7.3.1. Given all of these factors, Alternative 2 was determined to have conditionally significant adverse effects on the black-footed albatross with respect to incidental take. Given the current levels of incidental take, the existing measures in place to reduce incidental take of seabirds, and all of the above considerations, Alternative 4 is likely to have an insignificant impact on other albatross and shearwater species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 2 are considered insignificant at the population level for all albatross and shearwater species (Table 4.7-3).

Indirect Effects - Benthic habitat

Since these species are not benthic feeders, the impact of Alternative 2 on other albatross and shearwater species through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact would need to be considered in the balance of the beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all seabird species, including albatross and shearwaters (Table 4.7-3).

4.7.3.3 Effects of Alternative 3 on Other Albatrosses and Shearwaters

Direct Effects - Incidental take

The impacts of Alternative 3 on other Albatrosses and Shearwaters through incidental take is similar to the discussion of impacts on short-tailed albatross in section 4.7.2.2. See also the discussion above in section 4.7.3.1. Given all of these factors, Alternative 3 was determined to have conditionally significant adverse effects on the black-footed albatross with respect to incidental take. Given the current levels of incidental take, the existing measures in place to reduce incidental take of seabirds, and all of the above considerations, Alternative 4 is likely to have an insignificant impact on other albatross and shearwater species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 3 are considered insignificant at the population level for all albatross and shearwater species (Table 4.7-3).

Indirect Effects - Benthic habitat

Since these species are not benthic feeders, the impact of Alternative 3 on other albatross and shearwater species through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for albatross and shearwater species (Table 4.7-3).

4.7.3.4 Effects of Alternative 4 on Other Albatrosses and Shearwaters

Direct Effects - Incidental take

The impacts of Alternative 4 on other Albatrosses and Shearwaters through incidental take is similar to the discussion of impacts on short-tailed albatross in section 4.7.2.2. See also the discussion above in section 4.7.3.1. Given all of these factors, Alternative 4 was determined to have conditionally significant adverse effects on the black-footed albatross with respect to incidental take. Given the current levels of incidental take, the existing measures in place to reduce incidental take of seabirds, and all of the above considerations, Alternative 4 is likely to have an insignificant impact on other albatross and shearwater species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 4 are considered insignificant at the population level for all albatross and shearwater species (Table 4.7-3).

Indirect Effects - Benthic habitat

Since these species are not benthic feeders, the impact of Alternative 4 on other albatross and shearwater species through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for albatross and shearwater species (Table 4.7-3).

4.7.3.5 Effects of Alternative 5 on Other Albatrosses and Shearwaters

Direct Effects - Incidental take

The effects of Alternative 5 with respect to incidental take are expected to be similar to the effects of Alternative 1 (Section 4.7.3.1). Alternative 5 could have conditionally significant adverse effects on the black-footed albatross and insignificant impacts on other albatross and shearwater species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effects on prey abundance and availability of Alternative 5 are considered insignificant at the population level for all albatross and shearwater species (Table 4.7-3).

Indirect Effects - Benthic habitat

Since these species are not benthic feeders, the impact of Alternative 5 on other albatross and shearwater species through benthic habitat effects is considered insignificant (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for albatross and shearwater species (Table 4.7-3).

4.7.4 Effects on Piscivorous Species

Birds that breed in Alaska and prey on forage fish are more likely to be impacted by indirect fishery effects on prey abundance and availability. This group includes murres, kittiwakes, gulls, rhinoceros auklets, puffins, cormorants, jaegers, terns, guillemots, and murrelets. Some species also include prey items other than fish in their diet.

In general, the majority of breeding piscivorous seabirds forage within 40 to 60 km of their colonies, particularly during the chick-rearing phase.⁵ Black-legged kittiwakes and thick-billed murres forage out to distances of 100 km in shallow waters off the Pribilof Islands (Schneider and Hunt, 1984). Seabirds usually show asymmetrical distribution around the colonies because foraging distribution is not entirely related to distance (Schneider and Hunt, 1984). Prey type and availability are influenced by oceanographic environments, such as distance from shelf break, currents, and water depth.

4.7.4.1 Effects of Alternative 1 on Piscivorous Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 1 is likely to have an insignificant impact on piscivorous species.

Indirect Effects - Prey (forage fish) abundance and availability

To the extent that management measures under Alternative 1 (or any other alternatives) close or restrict access to the immediate vicinity of seabird colonies and surrounding foraging waters during the breeding season of May through August, potential indirect effects on forage fish prey species available to breeding seabirds would be reduced. To the extent that nearshore waters of the colonies are accessible, the potential for indirect fishery effects exists (see Figures 2.3-1 for the proposed Alternative 1 measures; see Figures 4.7-1 and 4.7-2 for seabird colonies in the BSAI and GOA). Under Alternative 1, area restrictions include no transit zones within 3 nautical miles of 37 rookeries and closure within 10 nm of 37 rookeries to all trawling year-round, some extending to 20 nm on a seasonal basis. This alternative offers no protective buffers around St. Matthew/Hall Islands, one of the largest seabird colonies, and a minimal buffer (10 nm) around St. Paul, Chagulak, and Choweit Island (in the Semidi Islands group)—other very large seabird colonies. Given that there is insufficient information about the potential effects of fishery harvest on forage fish abundance and availability, Alternative 1 has unknown effects on piscivorous seabird populations that breed in Alaska..

Indirect Effects - Benthic habitat

To the extent that the impact of bottom trawl gear on the benthic habitat reduces the availability of prey that scoters, guillemots, cormorants or other benthic-feeding seabirds feed on, then bottom trawl activity could have a negative effect on these seabirds. The foraging areas of scoters, guillemots, and cormorants are typically within 10 nm of shore. Effects of bottom trawling on benthic habitat in all nearshore seabird foraging areas is not fully known. Benthic trawling is known to reduce abundance and diversity of sedentary

⁵K. Kuletz, "Personal Communication," USFWS, 1011 E. Tudor Rd., Anchorage, AK 99501.

organisms (NMFS, 2001a). Thus the potential exists for impacts on nearshore generalists that depend on a wide variety of prey species. The possibility that nearshore trawling could impact sand lance seems likely, since these forage fish depend on sandy bottoms and use the substrate (Dick and Warner, 1982). Effects on sand lance could potentially impact nearshore fish feeders like guillemots, marbled murrelets, Kittlitz's murrelets (Golet et al., 2000; Nelson, 1997; Day et al., 1999). Under Alternative 1, the 3 nautical miles no transit zones near SSL rookeries and the no groundfish fishing within 3 nautical miles of SSL haulouts could provide protective buffers from any potential negative effects of bottom trawl gear on those benthic habitats. There are some gaps in our knowledge which affect this analysis, such as the amount of seabird foraging that takes place outside these buffer zones and the effects of bottom trawling on forage fish abundance and distribution. Both factors are probably highly variable in different places and seasons. Given the above considerations, Alternative 1 is not expected to affect benthic-feeding species such as scoters, guillemots, cormorants at a population level and is therefore considered to have an insignificant impact on these benthic-feeding seabird species (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all piscivorous species (Table 4.7-3).

4.7.4.2 Effects of Alternative 2 on Piscivorous Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 2 is likely to have an insignificant impact on piscivorous species.

Indirect Effects - Prey (forage fish) abundance and availability

Measures proposed for Steller sea lions that slow down, spread out, or otherwise reduce the intensity of certain groundfish fisheries might coincidentally enhance the foraging success of seabirds. To the extent that management measures under Alternative 2 (or any other alternatives) close or restrict access to the immediate vicinity of seabird colonies and surrounding foraging waters during the breeding season of May through August, potential indirect effects on forage fish available to breeding seabirds would be reduced. To the extent that nearshore waters of the colonies are accessible to commercial fishing vessels, the potential for indirect fishery effects exists (see Figure 2.3-2 for Alternative 2 measures; see Figures 4.7-1 and 4.7-2 for seabird colonies). Under Alternative 2, area restrictions to all groundfish fisheries include: no transit zones within 3 nautical miles of 37 rookeries, no groundfish fishing within 3 nautical miles of haulouts, and no trawling for any groundfish species within SSL critical habitat. Additionally, the Aleutian Islands would be closed to pollock fishing. Some of the major colonies that would be buffered from potential indirect fishery effects include: Buldir Island, Chagulak Island, Semidi Islands, Pribilof Islands, St. Matthew/Hall Islands, and St. Lawrence Islands. Given that there is insufficient information about the potential effects of fishery harvest on forage fish abundance and availability, Alternative 2 could have unknown effects on piscivorous seabird populations that breed in Alaska.

Indirect Effects - Benthic habitat

Under Alternative 2, trawling for any groundfish species is prohibited in SSL critical habitat (Figure 2.3-2). Whereas none of the alternatives are expected to impact benthic habitat at levels that would impact seabirds at population levels, the protective measures (trawl closures and TAC reductions) under Alternative 2 go the furthest to protect and buffer the nearshore benthic-feeding seabirds from any potential negative effects of

bottom trawl gear on benthic habitat. The effects of Alternative 2 on benthic habitat are therefore considered insignificant to all seabird populations (Table 4.7-3).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact would need to be considered in the balance of the beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all piscivorous seabird species (Table 4.7-3).

4.7.4.3 Effects of Alternative 3 on Piscivorous Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 3 is likely to have an insignificant impact on piscivorous species.

Indirect Effects - Prey (forage fish) abundance and availability

Except for the Chagulak Island colony, three of the four major piscivorous seabird colonies occur within closed areas under Alternative 3 (see Figure 2.3-3 for Alternative 2 measures; see Figure 4.7-1 for seabird colonies). This could reduce the potential indirect effects of fishing on prey abundance and availability in seabird forage areas near colonies. Given that there is insufficient information about the potential effects of fishery harvest on forage fish abundance and availability, Alternative 3 could have unknown effects on piscivorous seabird populations that breed in Alaska.

Indirect Effects - Benthic habitat

Although not as extensive as the closures under Alternative 2, trawl closures under Alternative 3 could potentially benefit benthic-feeding seabird species. The effects of Alternative 3 on benthic habitat are therefore considered insignificant to all seabird populations (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all piscivorous species (Table 4.7-3).

4.7.4.4 Effects of Alternative 4 on Piscivorous Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 4 is likely to have an insignificant impact on piscivorous species.

Indirect Effects - Prey (forage fish) abundance and availability

Numerous area closures are proposed under Alternative 4 (Figures 2.3-4 to 2.3-7) and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects to some seabirds in some areas during the breeding season. Given that there is insufficient information about the potential effects of fishery harvest on forage fish abundance and availability, Alternative 4 could have unknown effects on piscivorous seabird populations that breed in Alaska.

Indirect Effects - Benthic habitat

Numerous area closures are proposed under Alternative 4 (Figures 2.3-4 to 2.3-7) and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects for benthic-feeding seabird species. The effects of Alternative 4 on benthic habitat are therefore considered insignificant to all seabird populations (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all piscivorous species (Table 4.7-3).

4.7.4.5 Effects of Alternative 5 on Piscivorous Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 5 is likely to have an insignificant impact on piscivorous species.

Indirect Effects - Prey (forage fish) abundance and availability

The protective measures under Alternative 5 are less extensive than those under Alternative 3. For instance, the haulouts on St. Matthew and St. Lawrence Islands are not protected by any closures or gear restriction buffers (Figure 2.3-8) as they are in Alternatives 2, 3, and 4. Given that there is insufficient information about the potential effects of fishery harvest on forage fish abundance and availability, Alternative 5 could have unknown effects on piscivorous seabird populations that breed in Alaska.

Indirect Effects - Benthic habitat

The effects of Alternative 5 on benthic habitat are considered to be similar to those of Alternative 1 (Section 4.7.4.1). Alternative 5 is not expected to affect benthic-feeding species such as scoters, guillemots, or cormorants at a population level and is therefore considered to have an insignificant impact on these benthic-feeding seabird species (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all piscivorous species (Table 4.7-3).

4.7.5 Effects on Spectacled and Steller's Eiders

Spectacled and Steller's eiders are listed as threatened species under the Endangered Species Act (ESA). The history of ESA section 7 consultations and NMFS actions carried out as a result of those consultations are described in section 2.9.5 of the Draft Programmatic SEIS (NMFS, 2001a). Their life history, population biology, and foraging ecology are described in section 3.5.1.15 of that document.

The USFWS published final rules designating critical habitat for the spectacled eider (66 FR 9146; February 6, 2001) and the Steller's eider (66 FR 8850; February 2, 2001). The marine areas designated as critical habitat are reduced from the areas that were proposed and discussed in sections 2.9.5.2 and 2.9.5.3 of the Draft Programmatic SEIS (NMFS, 2001a).

Except for consideration of critical habitat, the effects on other seaducks such as scoters, long-tailed ducks, and harlequin ducks would be similar to the effects on these two eider species.

4.7.5.1 Effects of Alternative 1 on Spectacled and Steller's Eiders

Direct Effects - Incidental take

Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a) indicates that spectacled and Steller's eiders are not likely to be directly affected by the BSAI and GOA groundfish fisheries. Therefore, any effects of incidental take are insignificant (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 1 are considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

Indirect Effects - Benthic habitat

Based on a geographical information system (GIS) mapping analysis of 1999 groundfish observer data and the spectacled eider critical habitat, no areas of overlap occurred (Figure 3.7-1). Thus it is not likely that the BSAI and GOA groundfish fisheries would impact benthic habitat that is potentially directly used by spectacled eiders. The four marine units that are designated as critical habitat for the Steller's eider are Kuskokwim Shoals and three areas on the north side of the Alaska Peninsula [Nelson Lagoon (including portions of Port Moller and Herendeen Bay), Izembek Lagoon, and Seal Island]. In mid-May 1999, two vessels using bottom trawl gear targeted yellowfin sole out of the "North Kuskokwim Area" (now called Kuskokwim Shoals) in the Steller eider critical habitat (in Area 514). Both vessels were over 200 ft LOA, therefore had 100% observer coverage. The estimated harvest of yellowfin sole from these two vessels was 282.43 mt.

To the extent that the impact of bottom trawl gear on the benthic habitat reduces the availability of prey that eiders feed on, then bottom trawl activity could have a negative effect on eiders. The overlap of bottom trawl fisheries and Steller's eider critical habitat is relatively small, involving the yellowfin sole fishery in the northern portion of Kuskokwim Bay. This is a relatively small fishery (two vessels) in a limited geographic area. The effect of bottom trawling on benthic habitat in this area is not known, but would not be expected to affect spectacled or Steller's eiders at a population level. Therefore, the effects of any of the five alternatives on benthic habitat are considered insignificant to spectacled and Steller's eiders.

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

4.7.5.2 Effects of Alternative 2 on Spectacled and Steller's Eiders

Direct Effects - Incidental take

Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a) indicates that spectacled and Steller's eiders are not likely to be directly affected by the BSAI and GOA groundfish fisheries. Therefore, any effects of incidental take are insignificant (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 2 are considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

Indirect Effects - Benthic habitat

Since the overlap between the groundfish fisheries and eider critical habitat areas is very small, the impact of the Alternative 2 fisheries on eider benthic habitat is considered insignificant (see discussion under Section 4.7.5.1).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact would need to be considered in the balance of the beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all seabird species, including eiders (Table 4.7-3).

4.7.5.3 Effects of Alternative 3 on Spectacled and Steller's Eiders

Direct Effects - Incidental take

Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a) indicates that spectacled and Steller's eiders are not likely to be directly affected by the BSAI and GOA groundfish fisheries. Therefore, any effects of incidental take are insignificant (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 3 are considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

Indirect Effects - Benthic habitat

Since the overlap between the groundfish fisheries and eider critical habitat areas is very small, the impact of the Alternative 3 fisheries on eider benthic habitat is considered insignificant (see discussion under Section 4.7.5.1).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

4.7.5.4 Effects of Alternative 4 on Spectacled and Steller's Eiders

Direct Effects - Incidental take

Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a) indicates that spectacled and Steller's eiders are not likely to be directly affected by the BSAI and GOA groundfish fisheries. Therefore, any effects of incidental take are insignificant (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

Numerous area closures are proposed under Alternative 4 and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects to some seabirds in some areas during the breeding season. For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability

of Alternative 4 are considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

Indirect Effects - Benthic habitat

Since the overlap between the groundfish fisheries and eider critical habitat areas is very small, the impact of the Alternative 4 fisheries on eider benthic habitat is considered insignificant (see discussion under Section 4.7.5.1).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

4.7.5.5 Effects of Alternative 5 on Spectacled and Steller's Eiders

Direct Effects - Incidental take

Section 4.3.3 of the Draft Programmatic SEIS (NMFS, 2001a) indicates that spectacled and Steller's eiders are not likely to be directly affected by the BSAI and GOA groundfish fisheries. Therefore, any effects of incidental take are insignificant (Table 4.7-3).

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 5 are considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

Indirect Effects - Benthic habitat

Since the overlap between the groundfish fisheries and eider critical habitat areas is very small, the impact of the Alternative 5 fisheries on eider benthic habitat is considered insignificant (see discussion under Section 4.7.5.1).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for spectacled and Steller's eiders (Table 4.7-3).

4.7.6 Effects on Other Seabird Species

This group includes all other seabird species not listed above such as storm-petrels, crested auklet, and least auklet.

4.7.6.1 Effects of Alternative 1 on Other Seabird Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 1 is likely to have an insignificant impact on these seabird species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 1 are considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

Indirect Effects - Benthic habitat

Under Alternative 1, the 3 nautical mile no transit zones near SSL rookeries and the no groundfish fishing within 3 nautical miles of SSL haulouts could provide protective buffers from any potential negative effects of bottom trawl gear on benthic habitat. To the limited extent that any of these species depend on benthic prey production and distribution, they would be expected to be effected in a similar manner as discussed in Section 4.7.4.1. The impact of Alternative 1 on the benthic habitat of these species is therefore considered insignificant at the population level (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

4.7.6.2 Effects of Alternative 2 on Other Seabird Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 2 is likely to have an insignificant impact on these seabird species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 2 are considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

Indirect Effects - Benthic habitat

Under Alternative 2, trawling for any groundfish species is prohibited in SSL critical habitat (Figure 2.3-2). This could potentially benefit benthic-feeding seabird species occurring within SSL critical habitat; thus Alternative 2 is more protective than Alternative 1. The effects of Alternative 2 on benthic habitat are therefore considered insignificant to all seabird populations (Table 4.7-3).

Indirect Effects - Processing waste and offal

TAC level reductions and area restrictions under Alternative 2 could reduce the amount of processing waste and offal that is available to scavenging seabirds, particularly in some areas near major breeding colonies. This impact should be considered in the balance of the beneficial and detrimental impacts of this effect. See section 4.7.1.1 above. This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for all seabird species (Table 4.7-3).

4.7.6.3 Effects of Alternative 3 on Other Seabird Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 3 is likely to have an insignificant impact on these seabird species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 3 are considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

Indirect Effects - Benthic habitat

Although not as extensive as the closures under Alternative 2, trawl closures under Alternative 3 could potentially benefit benthic-feeding seabird species. The impact of Alternative 3 on the benthic habitat of these species is therefore considered insignificant at the population level (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

4.7.6.4 Effects of Alternative 4 on Other Seabird Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 4 is likely to have an insignificant impact on these seabird species.

Indirect Effects - Prey (forage fish) abundance and availability

Numerous area closures are proposed under Alternative 4 and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects to some seabirds in some areas during the breeding season. For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 4 are considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

Indirect Effects - Benthic habitat

Numerous area closures are proposed under Alternative 4 (Figures 2.3-4 to 2.3-7) and to the extent that fishing effort occurred in these areas prior to the proposed closures, such changes could represent potential beneficial effects for benthic-feeding seabird species. The effects of Alternative 4 on benthic habitat are therefore considered insignificant to all seabird populations (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

4.7.6.5 Effects of Alternative 5 on Other Seabird Species

Direct Effects - Incidental take

Given the current levels of incidental take (Table 4.7.1) and the existing measures in place to reduce incidental take of seabirds, Alternative 5 is likely to have an insignificant impact on these seabird species.

Indirect Effects - Prey (forage fish) abundance and availability

For the reasons noted in the Draft Programmatic SEIS and summarized in section 4.7 above, the potential indirect fishery effect on prey abundance and availability of Alternative 5 are considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

Indirect Effects - Benthic habitat

The effects of Alternative 5 on benthic habitat are considered to be similar to those of Alternative 1 (Section 4.7.6.1). Alternative 5 is therefore considered to have an insignificant impact on these seabird species (Table 4.7-3).

Indirect Effects - Processing waste and offal

This indirect effect potentially has both beneficial and detrimental impacts and overall could be considered insignificant at the population level for non-piscivorous seabird species (Table 4.7-3).

4.7.7 Summary of the Effects of the Alternatives on Seabirds and Re-initiation of Section 7 Consultation on ESA Listed Seabirds

The effects analysis did not result in the identification of any one single alternative that protected seabirds more than another alternative. However, it did highlight effects on seabird species that are of particular note:

- Unknown effect of incidental take on fulmar populations in the BSAI under Alternatives 1, 3, 4, and 5.
- Conditionally significant adverse effect of incidental take on the endangered short-tailed albatross and on the black-footed albatross under all alternatives.
- Unknown indirect fishery effect of prey abundance and availability on breeding piscivorous seabirds.
- Conditionally significant beneficial effect of availability of processing waste and offal to fulmars under Alternatives 1, 3, 4, and 5.

Table 4.7-3 Summary of effects of Alternatives 1 through 5 on seabirds.

Species/Species Groups	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Northern Fulmar					
Incidental take-BSAI	U	I	U	U	U
Incidental take-GOA	I	I	I	I	I
Prey availability ^a	I	I	I	I	I
Benthic habitat	I	I	I	I	I
Proc. waste & offal	CS+	I	CS+	CS+	CS+
Short-tailed Albatross					
Incidental take	CS-	CS-	CS-	CS-	CS-
Prey availability ^a	I	I	I	I	I
Benthic habitat	I	I	I	I	I
Proc. waste & offal	I	I	I	I	I
Other Albatrosses & Shearwaters					
Incidental take ^b	CS-	CS-	CS-	CS-	CS-
Prey availability ^a	I	I	I	I	I
Benthic habitat	I	I	I	I	I
Proc. waste & offal	I	I	I	I	I
Piscivorous Seabirds (also breeding in Alaska) ^c					
Incidental take	I	I	I	I	I
Prey availability ^a	U	U	U	U	U
Benthic habitat	I	I	I	I	I
Proc. waste & offal	I	I	I	I	I
Eiders (Spectacled and Steller's) ^d					
Incidental take	I	I	I	I	I
Prey availability ^a	I	I	I	I	I
Benthic habitat	I	I	I	I	I
Proc. waste & offal	I	I	I	I	I
Other Seabird Species ^e					
Incidental take	I	I	I	I	I
Prey availability ^a	I	I	I	I	I
Benthic habitat	I	I	I	I	I
Proc. waste & offal	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

^aThis indirect effect includes impacts to prey availability caused by vessel presence/disturbance to seabirds foraging near seabird colonies.

^bCS- applies to the black-footed albatross only.

^c Fish-eating seabirds that include species of: murres, kittiwakes, gulls, rhinoceros auklets, puffins, cormorants, jaegers, terns, guillemots, and murrelets.

^d Except for consideration of critical habitat, the effects on other seaducks such as scoters, long-tailed ducks, and harlequin ducks, would be similar as the effects on these eider species.

^e Represents all other seabird species not listed above, such as, storm-petrels, crested auklet, and least auklet.

Status of ESA Section 7 Consultations: NMFS initiated two Section 7 consultations with USFWS in 2000. The first FMP-level consultation is on the effects of the BSAI and GOA FMPs in their entirety on the listed species (and any designated critical habitat) under the jurisdiction of the USFWS. The second consultation is action-specific and is on the effects of the 2001 to 2004 TAC specifications for the BSAI and GOA groundfish fisheries on the listed species (and any critical habitat) under the jurisdiction of the USFWS. This action-specific consultation will incorporate the alternatives proposed in this SEIS for the 2002 groundfish fisheries. The most recent Biological Opinion on the effects of the groundfish fisheries on listed seabird species expired December 31, 2000. NMFS requested and was granted an extension of that Biological Opinion and its accompanying Incidental Take Statement. USFWS intends to issue a Biological Opinion in late 2001. This will allow for the consideration of new information: recommendations by Washington Sea Grant Program on suggested regulatory changes to seabird avoidance measures based on a two-year research program as well as Council and NMFS action on the proposed alternatives in this SEIS.

Figure 4.7-1 Piscivorous seabird colonies in the BSAI in relationship to Alternative 4- Area and Fishery Specific Approach- Pacific Cod Fisheries

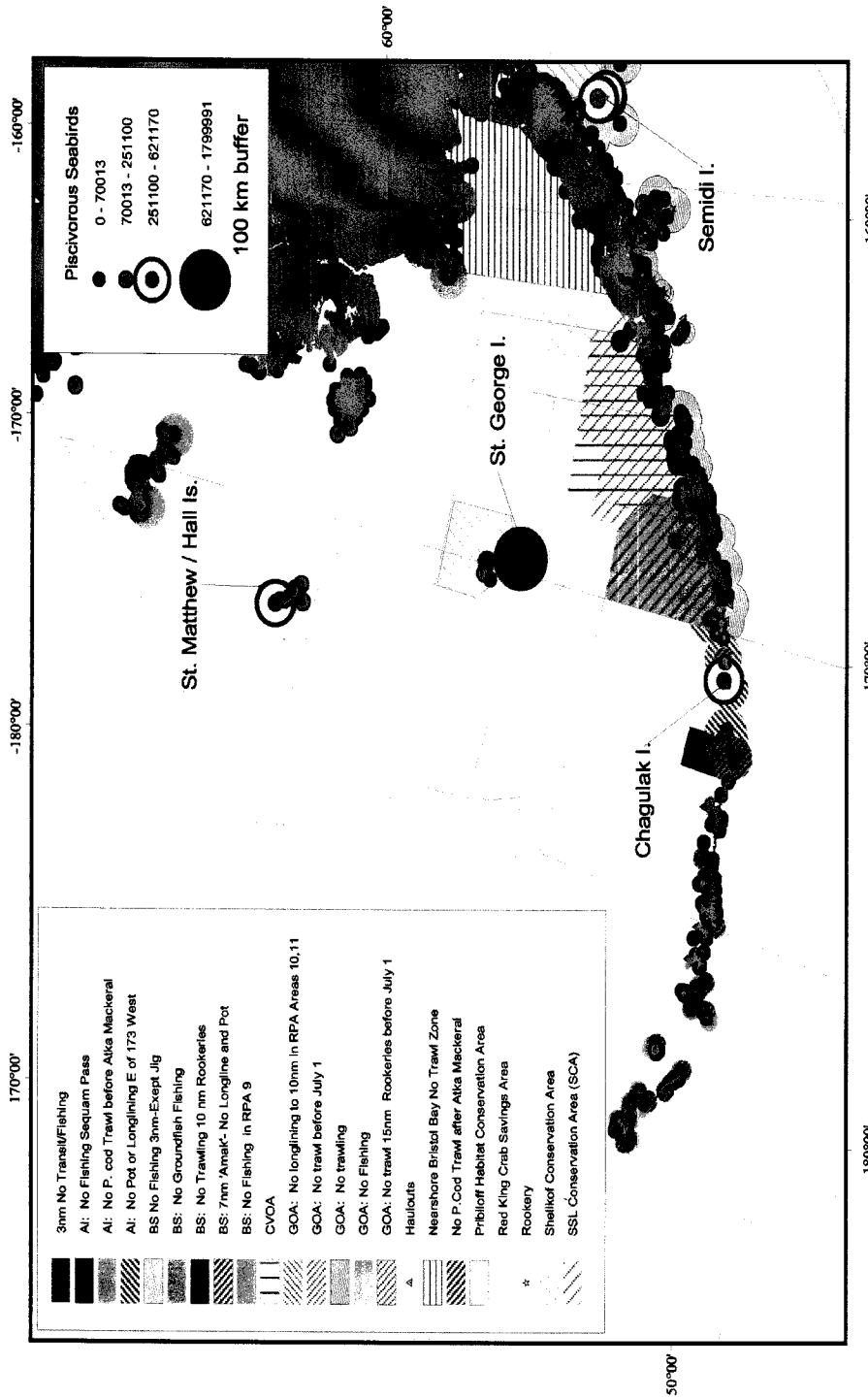


Figure 4.7-2 Piscivorous seabird colonies in the GOA in relationship to Alternative 4- Area and Fishery Specific Approach- Pacific Cod Fisheries

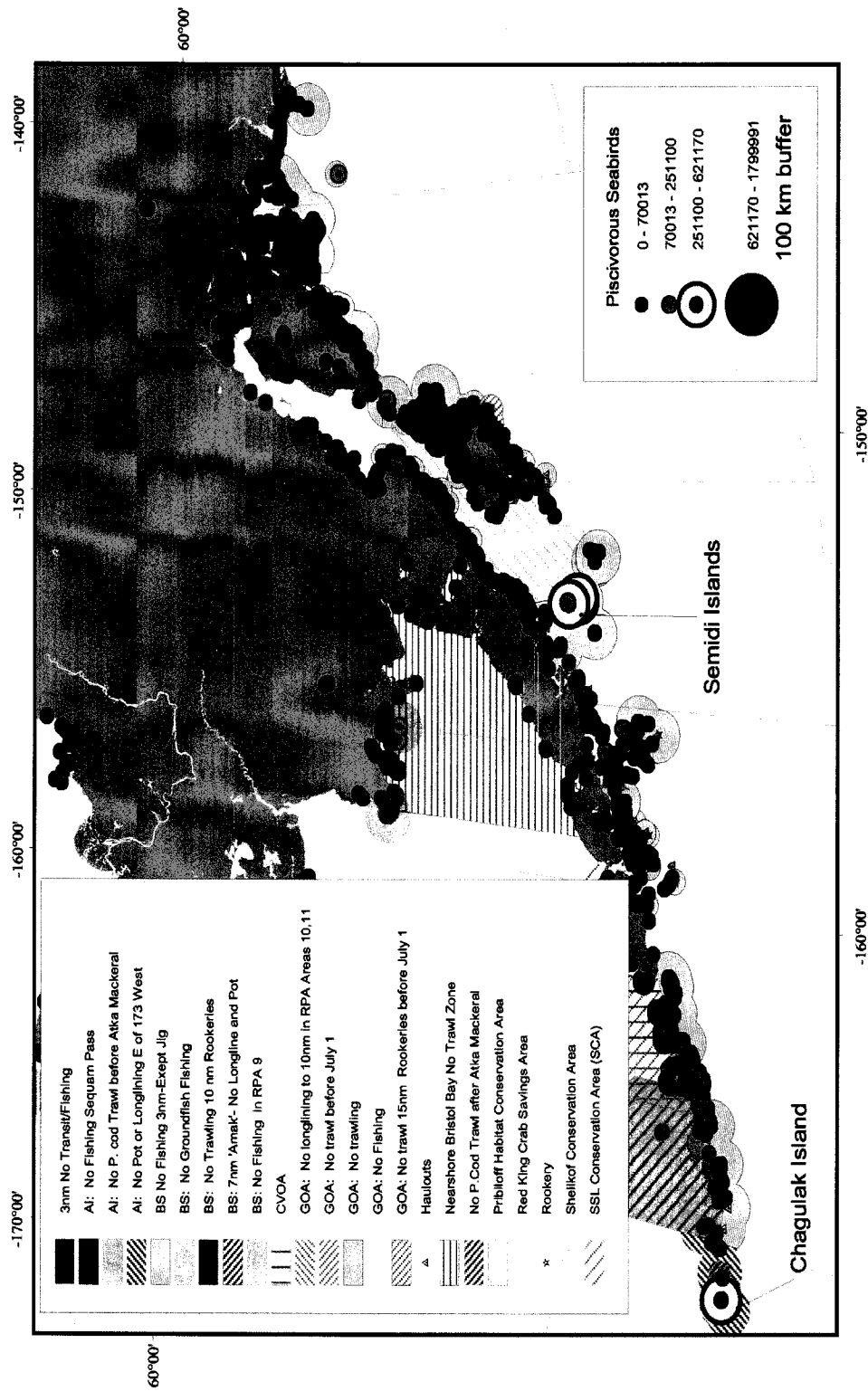


Figure 4.7-3 Short-tailed Albatross (STAL) sightings (by breeding season and take locations) in the BSAI in relationship to Alternative 2 - Low and Slow Approach

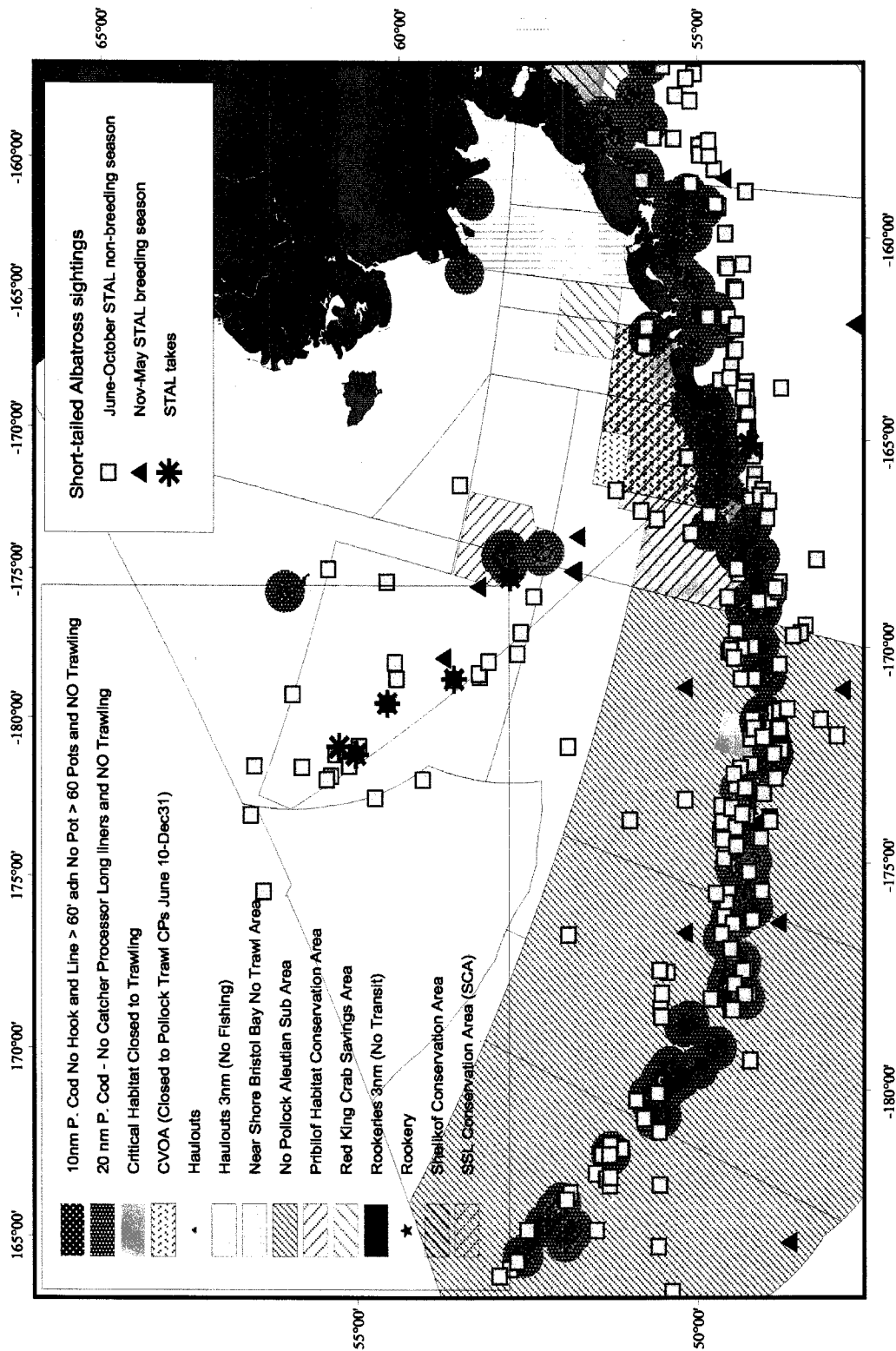
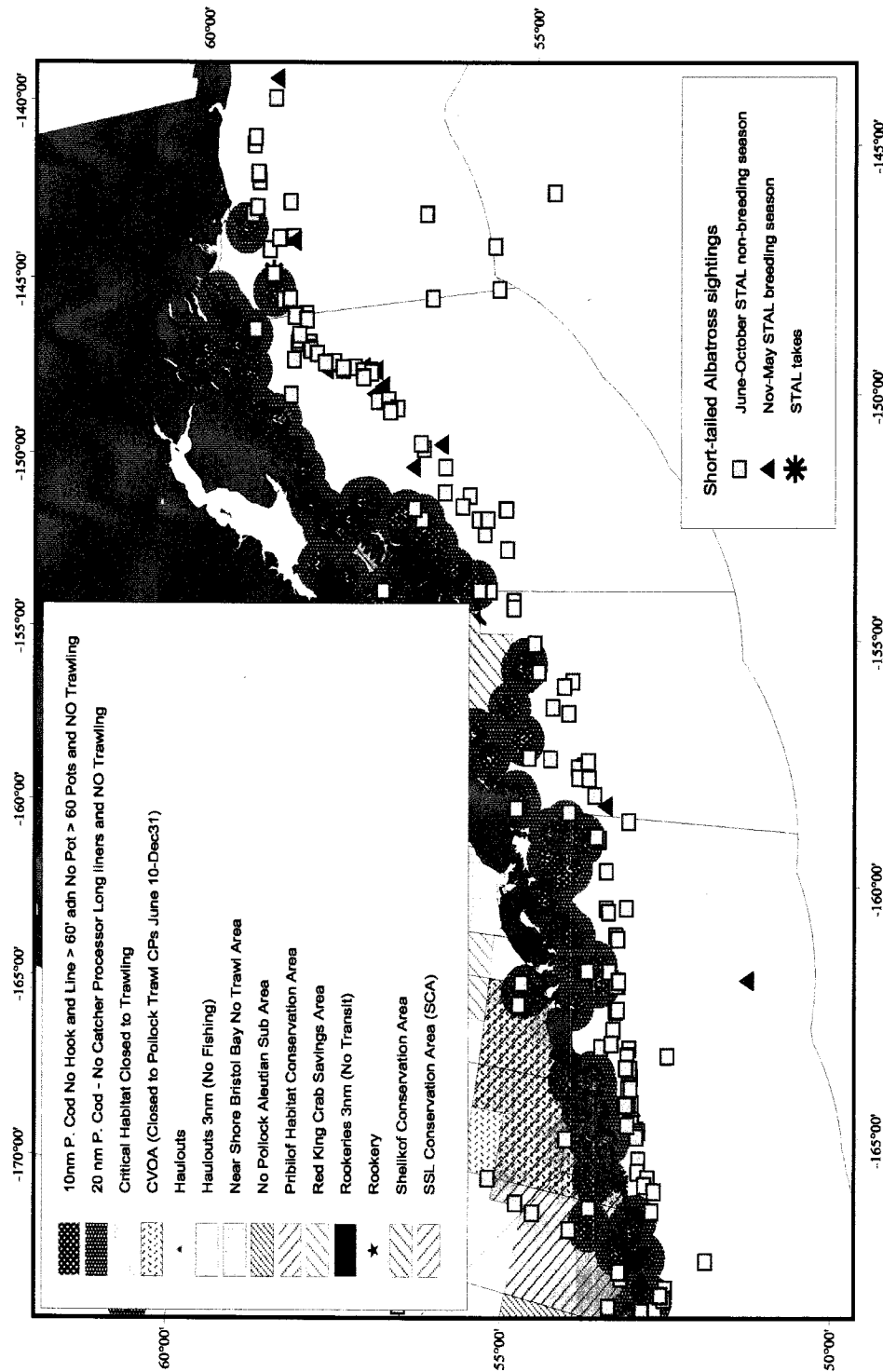


Figure 4.7-4 Short-tailed Albatross (STAL) sightings (by breeding season and take locations) in the GOA in relationship to Alternative 2 - Low and Slow Approach



4.8 Effects of the Alternatives on Marine Benthic Habitat

This section focuses on the effects of fishing on benthic habitat important to commercial fish species, their prey, and the ecosystem. Section 3.8 summarized what is known about these effects and explained the regulatory meaning of EFH (Essential Fish Habitat). Other sections of this SEIS consider closely related topics. Potential impacts to predator/prey relationships, which is an EFH concern, is dealt with in Section 4.9 on ecosystem considerations.

The analysis also provides the information necessary for an EFH assessment, which is required by the Magnuson-Stevens Act for any action that may adversely affect EFH. A full description of the action is contained in section 2 of this SEIS. The analysis of the effects of the action on EFH are described in this section. The determination regarding the effects of the alternatives on EFH and measures to mitigate any adverse effects are in the summary of this section. The technical guidance on EFH issued by NMFS (1998f) to aid regional fishery management councils in implementing the EFH requirements of the Magnuson-Stevens Act advises focusing the assessment on whether "anthropogenic factors reduce habitat suitability for marine resources." That fits with the NEPA requirement to evaluate factors which affect the human environment.

The two issues of prime concern with respect to EFH effects are the potential for damage or removal of fragile biota that are used by fish as habitat, the potential reduction of habitat complexity, which depends on the structural components of the living and nonliving substrate; and potential reduction in benthic diversity from long-lasting changes to the species mix. As discussed in Section 3.8, comparison of the available literature to some of the fishing methods used in Alaskan waters indicate that these fisheries are very likely to affect emergent epifauna (HAPC species) and can also change the structure of nonliving substrates as well as infauna and epifauna communities (i.e. Freese et al. 1999, McConnaughey et al. 2000).

Each alternative is rated as to whether it may have significant or conditionally significant effects according to the following criteria, which are grouped into five categories (Table 4.8-1):

1. Damage to or removal of Habitat Areas of Particular Concern (HAPC) biota by trawl gear
2. Damage to or removal of HAPC biota by fixed gear
3. Modification of nonliving substrate, and/or damage to small epifauna and infauna by trawl gear
4. Modification of nonliving substrate, and/or damage to small epifauna and infauna by fixed gear
5. Reduction in benthic biodiversity

HAPC biota are taxa which form living substrate, and are identified by NMFS as meeting the criteria for special consideration in resource management, as was explained in Sec. 3.8. Several groups of organisms have been identified as HAPC in Alaska: coral, sponges, anemones, sea whips and sea pens. Bycatch of HAPC species in both trawl and longline gear is of concern (Table 4.8-2). Concentrations of HAPC species often occur in nearshore shallow areas but also are found in offshore deep water areas with substrata of high microhabitat diversity.

The analytical approach to the third category above has been changed slightly from the parallel category in the Groundfish Draft Programmatic SEIS (NMFS, 2001a); the effects on epifauna and infauna together with "modifications to the nonliving substrate" in which they live have been combined. The fourth category, "modifications to nonliving substrate, and/or damage to small epifauna and infauna by fixed gear" is somewhat hypothetical, as problems identified for fixed gear have centered on the bycatch of HAPC species and not on direct gear impacts to the seafloor.

Table 4.8-1 Criteria for determining significance of effects Alternatives 1-5 on Essential Fish Habitat

Issue	Direct Effects	Significant Negative	Conditionally Significant Negative	Insignificant	Conditionally Significant Positive	Significant Positive
Removal of fragile biota that may be used as habitat by fish	Removal of or damage to HAPC biota by bottom trawl gear.	Potential for substantial trawling effort in areas with high concentrations of HAPC species, not offset by large closures or TAC reductions.	Potential for moderate trawling effort in areas with high concentrations of HAPC species, not offset by increase in closures or TAC reductions.	Minimal potential for change in patterns of trawling effort in areas of high concentration of HAPC species.	Moderate increase in closures to trawling in areas of high density of HAPC species, not offset by displacement of effort elsewhere.	Large increase in closures to trawling in areas of high density of HAPC species, not offset substantially by displacement of effort elsewhere.
Removal of fragile biota that may be used as habitat by fish	Removal of or damage to HAPC biota by fixed gear	Potential for substantial fixed gear effort in areas with high concentrations of HAPC species, not offset by large closures or TAC reductions.	Potential for moderate fixed gear effort in areas with high concentrations of HAPC species, not offset by large closures or TAC reductions.	Minimal change in patterns of fixed gear effort in areas of high concentration of HAPC species.	Moderate increase in closures to fixed gear in areas of high density of HAPC species, not offset by displacement of effort elsewhere.	Large increase in closures to fixed gear fishing in areas of high density of HAPC species, not offset substantially by displacement of effort elsewhere.
Habitat complexity	Modification of nonliving sub-strate and/or damage to small epifauna and infauna by trawling.	Substantial displacement of trawling effort, not offset by large closures or TAC reductions.	Moderate displacement of trawling effort, not offset by large closures or TAC reductions.	No change; or displacement in trawling effort offset by closures or TAC reductions.	Moderate increases in closure to trawling not offset by displacement of effort elsewhere.	Large increase in closures to trawling, not offset substantially by displacement of effort elsewhere.
Habitat complexity	Modification of nonliving sub-strate, and/or damage to small epifauna and infauna by fixed-gear.	[no criteria; significance of this effect has not been established]	Substantial displacement of fixed-gear effort, not offset by large closures or TAC reductions.	No change or moderate displacement of trawling effort.	Substantial increases in closures to fixed gear, not offset by displacement of effort elsewhere.	[no criteria; significance of this effect has not been established]
Benthic biodiversity	Habitat subject to change in biodiversity.	Potential for substantial displacement of fishing effort, not offset by large closures or TAC reductions.	Potential for moderate displacement of fishing effort, not offset by large closures or TAC reductions.	No change; or displacement in fishing effort offset by closures or TAC reductions.	Moderate increases in closure to fishing not offset by displacement of effort elsewhere.	Large increase in closures to trawling, not offset substantially by displacement of effort elsewhere.

The fifth category identifies an indirect effect of trawling, potential changes in biodiversity. Intensive fishing in an area can result in a change in species diversity by attracting opportunistic fish species which feed on animals that have been disturbed in the wake of the tow, or by reducing the suitability of habitat used by some species (Sec. 3.8). Changes in benthic biodiversity might flow from persistent direct effects that have been identified here, including removal and damage to HAPC biota and other epifauna and infauna.

Specific impacts to habitat from different management regimes are very difficult to assess. The ability to predict the potential effects on EFH of measures changing the geographical and seasonal patterns of fishing depends on having detailed information on habitat features, on the life history of living substrates, on the natural disturbance regime, on how fishing with different gear types and with different levels of intensity affects different habitat types. Particularly limiting is the lack of fine scale distribution data on habitat types and their coverage by fishing effort.

This analysis is qualitative because a quantitative model would not be feasible, given the complexity of some of the alternatives and options and the lack of necessary information. Instead, in analyzing the effects of fishing gear on habitat, two simplifying assumptions are made:

1. closing areas to trawling, or to fishing altogether, is beneficial to EFH.
2. increasing fishing effort in an area puts additional stresses on EFH.

Logically, the more area which is restricted or closed to fishing, the fewer alterations and disturbances to marine habitat are likely. Conversely, increasing fishing effort in an area will place additional stresses on EFH.

The criteria above are applied directly to the question of whether the alternative is likely to modify nonliving substrate, and/or to damage small epifauna and infauna, and to the question of alteration of benthic biodiversity. For the question of damage or removal of HAPC biota by bottom trawl gear or longline gear, we narrow the criteria to ask what potential the alternative has for substantial trawling in areas with high concentrations of HAPC species, and whether such potential would be offset by large closures or TAC reductions.

In all of these alternatives, the management measures being taken to protect Steller sea lions change the fisheries in profound ways which are likely to benefit EFH in some areas, but with possible increased stresses on the habitat elsewhere. In general, the benefits of increasing the size of closed areas are likely to outweigh the problems of displaced effort. It is not anticipated that displaced fishermen would find comparable abundances of targeted species in other areas; however, it is possible that some marginal grounds would be fished that would not often be sought out in the absence of the Steller sea lion protection measures. Not having experienced as much fishing effort previously, such areas would be more vulnerable to EFH impacts. Also, because their fish density would likely be lower, these grounds might require more effort than was required previously to catch the same amount of fish. In alternatives which decrease TAC or decrease TAC in CH, this problem would be at least partially mitigated. Another potential mitigating factor is the possibility that the fleet would not be able to catch the full TAC, particularly of Atka mackerel but also of Pacific cod, as some fishermen have testified would happen if Alternatives 2 or 3 were implemented.

Table 4.8-2 Average Bycatch and Bycatch Rates of HAPC Biota, for Pollock, Pacific cod, and Atka mackerel, in the Bering Sea and Aleutian Islands 1997-1999

Target Fishery	Area	Gear	Bycatch (kg)				Target Catch (mt)	Bycatch Rate (kg/mt Target)			
			Coral	Anem-one	Seawhip/ Pen	Sponge		Coral	Anem-one	Seawhip/ Pen	Sponge
Pollock	AI	BTR	0	0	0	0	917	0.0001	0.0000	0.0000	0.0001
Pollock	AI	PTR	0	0	0	0	15,254	0.0000	0.0000	0.0000	0.0000
Pollock	BS	BTR	61	711	50	8,032	22,634	0.0027	0.0314	0.0022	0.3549
Pollock	BS	PTR	6	829	220	17	1,000,879	0.0000	0.0008	0.0002	0.0000
P. cod	BSAI	HAL	1,428	86,063	2,731	3,688	104,437	0.0137	0.8241	0.0261	0.0353
P. cod	BSAI	Pot	152	33	0	517	17,283	0.0088	0.0019	0.0000	0.0299
P. cod	BSAI	BTR	3,830	12,641	221	72,281	60,565	0.0632	0.2087	0.0037	1.1935
A mack	WAI	BTR	1,266	48	3	20,173	22,987	0.0551	0.0021	0.0001	0.8776
A mack	CAI	BTR	14	55	8	613	20,533	0.0007	0.0027	0.0004	0.0298
A mack	EAI	BTR	714	95	23	6,263	14,259	0.0501	0.0067	0.0016	0.4392

Notes: AI - Aleutian Islands, CAI - Central AI, WAI - Western AI, EAI - Eastern AI

BTR - bottom trawl, PTR - pelagic trawl, HAL - hook-and-line

kg - kilograms, kg/mt - kilograms per metric ton, mt - metric tons

This analysis is limited to the impacts that these alternative management measures would have on EFH and the marine benthic habitat. Some biologists have suggested that a properly designed network of marine reserves, with about 20% of fishing area devoted to reserves, would be effective in preserving biodiversity. Although none of these measures, which are designed for a different purpose, quite achieve that purpose, one of the alternatives (2), when added together with other closed areas in the North Pacific, does cover more than 20% of EFH habitat (defined in the Groundfish Draft Programmatic SEIS as areas 500 meters or less).

The size of the areas that would be closed to trawling, to all fishing, or to fishing or trawling for Atka mackerel, Pacific cod and pollock, under each alternative are compared in Table 4.8-3. Areas closed only to pollock are not considered because pollock fishermen generally employ less invasive pelagic gear, which would be subject to damage on habitats with high relief. Removing all three species does not entirely protect an area, from an EFH perspective. The fisheries for yellowfin sole, rock sole, arrowtooth flounder, and other species, however, form a relatively small proportion of the total trawling effort in critical habitat. Atka Mackerel Pacific cod and pollock ranged from 96% to 98% of the total trawl catch in CH in the BSAI between 1995 and 1999, according to NMFS observer data.¹ In the GOA, the three target species accounted for between 81% and 94% of the trawl catch in CH over the same years. It changes the picture somewhat when pollock is excluded from the BSAI totals; Atka mackerel and Pacific cod together in those years brought in from 71% to 78% of the trawl catch in CH from 1995-1999.

Crucial to this discussion is the fact that critical habitat areas for Steller sea lions coincides closely with concentrations of HAPC biota in the Aleutian Islands, as can be seen in Figures 4.8-1 and 4.8-2 (note that gorgonian coral and sea sponges are being used as proxies for a number of species which tend to grow in similar ecological niches), as well as providing good habitat for Atka mackerel adults and late juveniles (Figure 4.8-3). Insufficient information exists to produce a similar map about spawning Atka mackerel, but they are known to spawn in the same areas in the nearshore habitat. Because the continental shelf widens

¹pers. comm. Lowell Fritz, Alaska Fisheries Science Center, 7600 Sand Point Way N.E. Seattle, WA 98115.

toward the east sponges and corals are distributed outside as well as inside of critical habitat in the GOA. Critical habitat also coincides with most of the areas less than 200 meters deep in the Aleutian Islands. Shelf bathymetry is shown in Figure 4.8-4 and Table 4.8-4.

The annual TAC amounts available under Alternatives 1 through 5 for pollock, Pacific cod, and Atka mackerel in the BSAI and GOA using 2001 ABCs and TACs are compared in Table 4.8-6.

Table 4.8-3 Areas closed and partially closed to fishing under Alternatives 1 through 5

Areas Closed or Partially Closed		Sq NM	Sq Km	% of Total CH* Closed	% of Regional CH Closed
ALL Alternatives	No transit zones within 3 nm of all rookeries	958	3,286	0.9	-
Alt 1	Closed within 10 nm or 20 nm of 37 rookeries to all trawling	11,953	40,996	11.3	-
	Additional no trawling areas Jan - June	7,866	9,830	2.8	-
	No Atka mackerel trawling in Central and Western AI	17,951	61,570	17.0	61.0
	All CH closed to trawling	105,387	361,467	100.00	-
Alt 2	P. cod, closed to catcher-processor longliners within 20 nm of rookeries and haulouts	84,886	291,150	80.6	-
	P. cod, closed to all longline vessels > 60' and to pot vessels with pot limit > 60, within 10 nm of rookeries and haulouts	28,962	99,337	27.5	-
Alt 3	Closed to trawling for A. mackerel, P. cod and pollock (includes no groundfish fishing within 3 nm of haulouts)	67,769	232,440	64.3	-
Alt 4	BS: No trawling for A. mackerel, P. cod or pollock** (includes Bogoslof no fishing area; also includes no fishing zones within 20 nm of 5 northern haulouts)	19,361	66,408	18.4	57.2
	Additional S. Bering Sea Pollock Restriction Zone	2,758	8,458	2.4	0.8
	BS: No longlines or pot (included in BS no trawling areas)	16,566	56,821	15.7	48.9
	AI: Closed to trawling for A. mackerel (includes Segum Pass)	19,859	66,071	18.3	65.4
	AI: Closed to pollock trawling (all CH in AI)	29,462	101,053	28.0	100.0
	AI: Closed to P. Cod trawling year round	7,350	25,210	7.0	25.0
	AI: No P. cod trawling before A. mackerel harvest limits reached	18,475	63,373	17.5	62.7
	AI: No cod fishing with longlines or pots	6,475	22,210	6.1	22.0
	GOA: Areas closed to P. cod, A. mackerel or pollock trawling (includes areas of no groundfish fishing)	24,673	84,628	23.4	58.6
	GOA: Areas also closed to longlines and pots (Some additional areas closed only to longlines)	19,361	29,348	8.1	25.3
Alt 4 Opt. 3	Gear Specific Zones for GOA P. cod fisheries Measured From Land				
	No trawling, only longline, pot and jig vessels, to 20 nm	49,345	169,250	46.8	117.3
	Only longliners < 60' & certain pot and jig vessels, to 12 nm	36,526	125,280	34.7	86.8
	Only small pot and jig vessels, up to 3 nm	13,492	46,276	12.8	32.1

Table 4.8-3 Continued

Areas Closed or Partially Closed		Sq NM	Sq Km	% of Total CH* Closed	% of Regional CH Closed
Alt 5	Closed within 10 or 20 nm of 37 rookeries to all trawling year-round	11,953	40,996	11.3	-
	Additional no trawling areas Jan - June (A. mackerel must be taken outside CH after harvest limits are met)	7,866	9,830	2.8	-
Prior Closures Affecting All Alternatives	Nearshore Bristol Bay No Trawl Area	19,068	65,400	-	6.5**
	Nearshore Bristol Bay No Trawl Area inside CH	1,378	4,588	-	0.5**
	Red King Crab Closure Area	3,999	13,715	-	1.4**
	Pribilof Habitat Conservation Area	5,746	19,707	-	2.0**
	Pribilof Conservation Area inside CH	2,109	7,234	-	0.7**
	CVOA	14,898	51,101	-	5.1**
	CVOA inside CH	13,375	45,876	-	4.6**
Critical Habitat	Shelikof Conservation Area	11,328	38,855	-	4.4**
	Shelikof Conservation Area within CH	9,387	32,198	-	3.7**
	SSL Conservation Area	24,118	82,723	-	8.2**
	CH in Bering Sea	33,850	116,101	32.1	100.0
	CH in Aleutian Islands	29,462	101,053	28.0	100.0
Critical Habitat	CH in Gulf of Alaska	42,075	144,314	39.9	100.0
	Total CH	106,410	361,468	100.0	-
*CH includes the 19 additional "RPA Sites" identified in Steller Sea Lion Site Tables, and includes the SSL Conservation Area.					
** Percentage of Full AI, GOA, or BS					
Note: Reductions in TAC and some seasonal or minor closures are not included in this table.					

Table 4.8-4 Shelf Bathymetry for North Pacific

	Area	Sq NM	Sq Km	% of ALL CH	% of Regional CH *
Bering Sea	Total Area	292,545	1,003,400	-	-
	200 meter shelf	220,983	757,951	-	-
	50 meter -shelf	97,355	333,920	-	-
Aleutian Islands	Critical Habitat	33,850	116,101	32.1	100.0
	200 m Shelf Protected by CH	18,011	61,776	-	8.2
	50 m Shelf Protected by CH	4,641	15,919	-	14.2
Gulf of Alaska (west of 144°)	Total Area	292,807	1,004,300	-	-
	200 meter shelf	10,260	35,191	-	-
	Critical Habitat Shelf Protected by CH	29,462 10,799	101,053 37,040	29.0 -	100.0 71.4
Alternative 4 Bathymetry ***	Total Area	256,243	878,890	-	-
	200 meter shelf	63,145	216,581	-	-
	Critical Habitat 200m Protected by CH	42,075 38,141	144,314 130,821	39.9 -	100.0 60.4
Alternative 4 Bathymetry ***	BS: 50m Shelf Protected by No Trawl Area	3,838	13,165	-	3.9
	BS: 200m Shelf Protected by No Trawl Area	8,397	28,800	-	8.8
	GOA: 200m Shelf Protected by No Trawl Area	24,667	84,605	-	39.1
	AI: 200m Shelf protected by Pollock Closures	10,799	37,140	-	100.0
	AI: 200m Shelf protected by Cod Closures, All Yr **	5,410	18,558	-	50.1
	AI: 200m Shelf protected by to Cod Bfr Atka limits met	6,827	23,416	-	63.2
	AI: 200m Shelf protected by to Atka Mackerel	6,099	20,919	-	56.5

* This number refers to the percentage of all shelf habitat within a region (BS, AI or GOA) that is contained within the closed area.

** after Atka Mackerel Harvest Limits are reached.

***Includes all closed areas associated with fishery

Table 4.8-5 Annual TACs of pollock, Pacific cod, and Atka mackerel under Alternatives 1 through 5 (based on 2001 TACs)

Area and Species	TAC (mt)				
	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Eastern Bering Sea Pollock	1,400,000	1,372,290	1,400,000	1,400,000	1,400,000
Aleutian Islands Pollock	23,800	2,000	23,800	23,800	2,000
GOA Pollock	99,350	44,509	81,882	99,350	99,350
Bering Sea/AI Pacific cod	188,000	153,652	188,000	188,000	188,000
GOA Pacific cod	50,848	31,639	50,848	50,848	50,848
Bering Sea and AI A. mackerel	69,300	42,207	69,300	69,300	69,300

Note: values are in metric tons

Source: Compiled from the 2001 TAC examples in section 2.3

4.8.1 Effects of Alternative 1 on Marine Benthic Habitat

Under Alternative 1, the no action alternative, regulatory measures implemented by emergency rule in 2001 to protect Steller sea lions would expire, while management measures adopted to protect Steller sea lions, through 1998 for pollock and Pacific cod and through 2000 for Atka mackerel, would remain in effect. The Steller sea lion protection measures that would continue in effect under Alternative 1 are:

- No transit zones within 3 nm of 37 rookeries
- Closure within 10 nm of 37 rookeries to all trawling year-round, some extending to 20 nm on a seasonal basis.

Other restrictions, involving TAC and seasonal restrictions on the Atka mackerel fishery, are not relevant to this discussion.

Under Alternative 1, as shown in Table 4.8-2 and Figure 4.8-5, about 14% of critical habitat (CH) would be closed to trawling year round. There would also be restrictions on the Atka mackerel fishery, aimed at apportioning the TAC seasonally and governing the amount of TAC that can be taken inside (40%) and outside (60%) CH.

Because of the known effects of trawling and fixed gear on HAPC species and expected effects of trawling on substrates and benthic fauna as outlined in Section 3.8, the effects of the no action alternative on EFH are determined to be conditionally significant adverse in all but the fourth category. This alternative has the potential for moderate to substantial trawling effort in areas with high concentrations of HAPC species, which is not offset by large closures or TAC reductions. This alternative offers less protection from habitat destruction than is present in the fishery under measures implemented by emergency rule in 2001, which has additional Steller sea lion protection measures in place (Table 4.8-6).

4.8.2 Effects of Alternative 2 on Marine Benthic Habitat

This alternative is the most protective alternative under consideration in terms of reducing competition for prey with Steller sea lions, and is also the most protective for EFH. Alternative 2 would prohibit all

trawling in critical habitat, and would also implement measures to spread the fishing effort over the entire year, while lowering the TAC limits for pollock, cod, and mackerel.

Alternative 2 takes a zonal approach to the gear types. All critical habitat, a total of 106,410 sq nm, would be closed to trawling for all groundfish species year round. Within CH, catcher-longliners greater than 60' would be excluded past the 10 nm zone, and only pot vessels with a 60 pot limit, all jig vessels, and longline vessels under 60' would be permitted to fish in the 3-10 nm zone (27% of CH). In other words, over a quarter of CH would be closed to most gear types.

The zonal approach to closures is quite protective of EFH and particularly of HAPC species and of nearshore HAPC areas. As described in Sec. 3.8.1, nearshore habitat provides spawning habitat for numerous fish species, including Atka mackerel, and the effect of this approach is that these nearshore areas are closed to all but the least invasive gear types.

Figures 4.8-1 and 4.8-2 show that a large proportion of observed concentrations of gorgonian coral and sponges in the AI would be protected by these closures. Preventing trawling in critical habitat in the Aleutian Islands also protects 71.4% of the 200m shelf in the Aleutian Islands, 8.2% of the 200m shelf in the Bering Sea, and 60.4% of the 200m shelf in the Gulf of Alaska.

Alternative 2 is the only alternative which lowers TAC limits globally (Table 4.8-6). Maximum TACs would be established as a percentage of the maximum ABC as follows: BS Pacific cod TAC, 71.8%, AI Pacific cod TAC, 71.8% of ABC; GOA Pacific cod TAC, 55.0% of ABC.

The reduction in TAC would mitigate possible negative effects of this alternative on EFH throughout the fishing grounds. Closing large areas to trawling, without reducing TAC, would result in increased fishing effort outside the reserves, which might include marginal areas that had not been fished heavily previously and which would require greater effort per unit of fish caught. However, the substantial TAC reductions required by Alternative 2 would offset this pressure. Alternative 2 is rated as significantly or conditionally positive in all categories, with the exception of modification or damage by fixed gear which is rated as insignificant. In effect, it would create large marine reserves, and the benefits to EFH could be considerable (Table 4.8-6).

4.8.3 Effects of Alternative 3 on Marine Benthic Habitat

This alternative would establish large areas of critical habitat where fishing for pollock, Pacific cod, and Atka mackerel is prohibited, and would restrict catch levels in remaining critical habitat areas.

The measures that would be implemented relevant to the EFH discussion are:

- No transit zones within 3 nm of 37 rookeries
- Closure within 10 nm of 37 rookeries to all trawling year-round, some extending to 20 nm on a seasonal basis.
- Closure areas to directed fishing for pollock, Pacific cod, and Atka mackerel inside specified sites (designated in NMFS 2000 Biological Opinion (NMFS 2000a) as Areas 2, 4, 6, 8, 8, 10, 11, 13) would be established.

A significant portion of CH, 63.7%, would be closed to trawling for Atka mackerel, Pacific cod and pollock under this alternative (Table 4.8-4). This alternative is less protective than Alternative 2, however. Looking at the closures for this alternative against Figures 4.8-1 and 4.8-2, it is clear that large areas containing

concentrations of corals, sponges and other species which provide fish habitat would not be protected as in Alternative 2. Furthermore, unlike Alternative 2, trawl fisheries for yellowfin sole, rock sole, arrowtooth flounder, and other species would remain open. As explained in the introduction to this section, these other fisheries are minor by comparison with the three species targeted. In critical habitat for the BSAI and GOA combined, Atka mackerel, Pacific cod and pollock together accounted for 94% of the trawl catch from 1994-1999, on average – but this figure is reduced to 74% when only Atka mackerel and Pacific cod are considered and pollock is removed from the totals. Furthermore, Alternative 3 closes areas to all directed fishing for the three species, including fixed gear. Therefore, some areas would be closed to longlining out to 20nm, whereas in Alternative 2, longliners are allowed between 10 and 20 nm. In that respect, Alternative 3 could be considered more protective. Overall, however, it is reasonable to conclude that although trawling will be reduced substantially in the closure areas proposed under Alternative 3, these will not be as effective in protecting EFH as the total trawl closures under Alternative 2.

The three trawl fisheries would be expected to redistribute effort to areas outside critical habitat. The annual overall TACs for all these fisheries in Alternative 3 is expected to remain the same as for Alternative 1, except for GOA pollock, which would be reduced by about 18% (Table 4.8-6). However, the TAC for the remaining open areas in CH would be severely restricted.

The redirected effort for pollock and P. cod in the Bering Sea will primarily involve grounds that are already being fished, so any effect on EFH would derive from the cumulative impact of repeated trawling (see Section 3.8). For these two fisheries in the GOA however, where the shelf is much more narrow, there is more likelihood that these fisheries would expand to marginal areas. This could have a deleterious effect on EFH, but P. cod fishermen in particular have testified before the Council that they might have to stop fishing altogether in light of these closures. Atka mackerel fishermen in the AI have also said that the closures in Alternative 3 and the TAC restrictions in the remaining CH areas would not allow them to remain viable.

Under the assumption that a substantial increase in the area protected from most trawling would benefit EFH, then this alternative would benefit EFH on balance, and is rated as conditionally significant positive, for removal and damage to HAPC species by trawling and longlining, for modification of living substrates, and for potential biodiversity changes. Modification or damage by fixed gear is rated as insignificant (Table 4.8-6).

4.8.4 Effects of Alternative 4 on Marine Benthic Habitat

This alternative was developed by the Council's RPA committee. Alternative 4 includes complicated fishery specific closures, with seasonal and catch apportionments for each fishery in each region. From the perspective of habitat protection, the most relevant management measures are those that involve general fishing area closures and area specific gear (particularly trawl gear) closures. These measures are outlined in the description of the alternatives contained in Section 2.3.

Under alternative 4, the areas closed to trawling for all three target species add up to about 50% of all critical habitat. There are additional closures for particular fisheries as described. Alternative 4, Option 3, most notably closes nearly 50,000 sq nm to cod trawling in the GOA, which would add about 23% to the CH closure figure. Some areas are closed to longline fishing as well, by area. Because the closures were designed to reduce disruption to the fisheries, displacement of effort to marginal areas should also be reduced. This would also mean that the resulting fisheries will more closely resemble those of Alternatives 1 and 5, with the addition of closures which, in part, protect relatively lightly fished areas.

A management scheme with such a patchwork of closures on a fishery by fishery basis is not likely to be as beneficial to habitat as complete closures. Under Alternative 4, most areas would allow trawling for at least one of the three species between 10 nm and 20 nm. For example, Area 12 in the AI is closed to Atka mackerel fishing but open for the most part to P. cod trawling. However, some protection is still offered, because P. cod and A. mackerel are fished in different areas and depths. At the same time, however, trawling for other species remains open. It is also possible that the closures to traditionally fished areas in the Eastern Aleutians will result in increased trawling and bottom impacts in some less heavily fished areas in the western Aleutian Islands. Similarly, the Pacific cod restrictions will likely displace effort to areas which are not currently being as intensively fished.

Alternative 4 offers less protection than Alternatives 2 and 3, but more than Alternatives 1 or 5. This is true in terms of size of fishing closures, and also in some of the details of management. For example, Alternative 4 prohibits fishing for pollock, cod, and mackerel within 3 nm of all haulouts, while Alternatives 2 and 3 prohibit all groundfish fishing in those areas. Alternative 3 also has severe TAC constraints on open areas in CH which are not present in Alternative 4. Alternative 5 prohibits only pollock fishing, 0-10 nm from 75 haulouts, and Alternative 1 offers no protection for haulouts.

Alternative 4 is rated conditionally significant adverse for HAPC biota, and insignificant for modification of nonliving substrates. Although it involves additional protection for habitat in some areas, these will likely be offset by additional pressures elsewhere resulting from these measures. The complexity of this alternative makes it especially hard to predict how the change in the fishery will affect benthic habitat (Table 4.8-6).

4.8.5 Effects of Alternative 5 on Marine Benthic Habitat

Alternative 5 was derived from the suite of RPA measures that were in place for the 2000 pollock and Atka mackerel fisheries, together with measures under consideration for the Pacific cod fishery, including seasonal apportionments and harvest limits within critical habitat. This alternative limits the amount of catch within CH to be in proportion to estimated fish biomass.

Under Alternative 5, closures to all trawling would be the same as under Alternative 1, the no action alternative. In addition, pollock fishing would be prohibited in the AI area, and closed within 10 or 20 nm of 75 haulouts, seasonally or year-round, based on use by Steller sea lions. Management measures for Atka mackerel would be the same as for Alternative 1.

For the purposes of evaluating habitat impacts, Alternative 5 would be slightly more protective than Alternative 1. However, eliminating pollock fishing and leaving other fisheries in an area cannot be considered beneficial to EFH. Therefore, Alternative 5 is rated the same as Alternative 1 (Table 4.8-6).

4.8.6 Summary of Effects on Marine Benthic Habitat and EFH Determination

Each alternative is rated as to whether it may have a significant or conditionally significant effect on EFH. These effects have been grouped into five categories as discussed above. The criteria used for describing the significance of the effects are outlined in Table 4.8-1 and the summary of effects on marine benthic habitat for each alternative in Table 4.8-6.

Table 4.8-6 Summary of effects of alternatives on marine benthic habitat

Habitat Complexity and benthic biodiversity	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Removal and damage to HAPC biota by bottom trawl gear	CS-	S+	CS+	CS-	CS-
Removal and damage to HAPC biota by fixed gear	CS-	CS+	CS+	CS-	CS-
Modification of nonliving substrates, damage to epifauna and infauna by trawl gear	CS-	CS+	CS+	I	CS-
Modification of nonliving substrates, damage to epifauna and infauna by fixed gear	I	I	I	I	I
Habitat subject to change in biodiversity.	CS-	CS+	CS+	I	CS-

Notes: CS+ = conditionally significant positive; CS- = conditionally significant negative; S+ = significant; I = insignificant

Essential Fish Habitat Determination

Alternative 1 does not close additional areas or offer measures which would offer protection to EFH. Negative impacts would continue to occur from fishing at about the same level as in the recent past. This alternative offers less protection from habitat destruction than is present in the fishery under measures implemented by emergency rule in 2001, which has additional Steller sea lion protection measures in place.

Alternative 2 offers the highest degree of restriction to the fishing effort and sets aside the largest area, in order to offer maximum protection for Steller sea lions. The large reserve areas will protect EFH, including substantial amounts of living substrates classified as HAPC biota and nearshore HAPC areas. The fishing effort will probably not be displaced to new areas because of the reduction of TAC for Pacific cod, Atka mackerel, and pollock.

Alternative 3 would prohibit trawling in large parts of CH for Steller sea lions. Limits will also be placed on the catch of each species within the remaining areas of critical habitat. However, the overall catch is anticipated to remain the same, with the exception of GOA pollock. Although the closed areas will offer protection to EFH, the displaced effort from those areas may cause some negative impacts in areas outside CH.

The measures in Alternative 4 may reduce the impacts of fishing on EFH within large parts of SSL CH, but impacts to EFH in other areas, some of which may have been only marginally fished before, may increase. That is, the likely effect of Alternative 4 is mixed, with decreased impact on the benthic habitat in some areas and increased impacts in others.

Alternative 5, in comparison to Alternative 1, offers a slight increase in protective measures to AI pollock EFH and a slight change in the seasonal distribution of the effort. However, impacts to EFH will basically remain the same as in the recent past and as offered in Alternative 1.

All of the alternatives have the potential for benthic disturbances that could result in regional adverse effects on EFH, or to a component of EFH such as certain HAPC biota. However, some of the alternatives have mitigating measures that would lessen the intensity of the effects or provide some benefit to EFH. In either case, due to insufficient information, it is difficult to determine whether any alternative will have an adverse effect on EFH that would jeopardize EFH, or provide substantial benefit which may substantially improve

EFH. In other words, based on the best scientific information available, certain fishing practices may have some level of significant effect on benthic habitat, but the significance cannot be stated with certainty. Specific to EFH, Alternatives 2 and 3 (in that order) offer to best protect or minimize the impact from fishing on EFH.

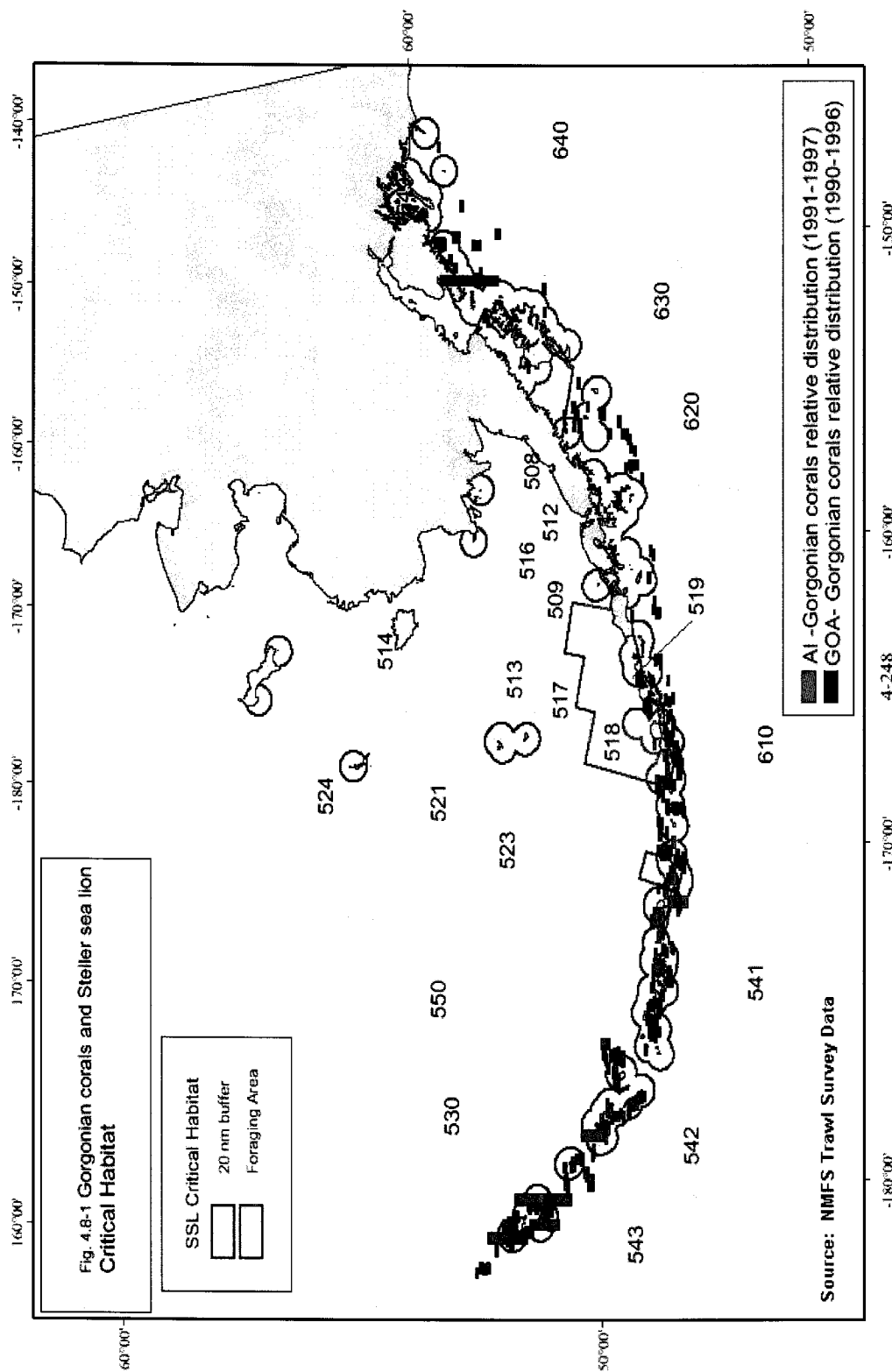


Figure 4.8-1 Gorgonian Corals and Steller Sea Lion Critical Habitat



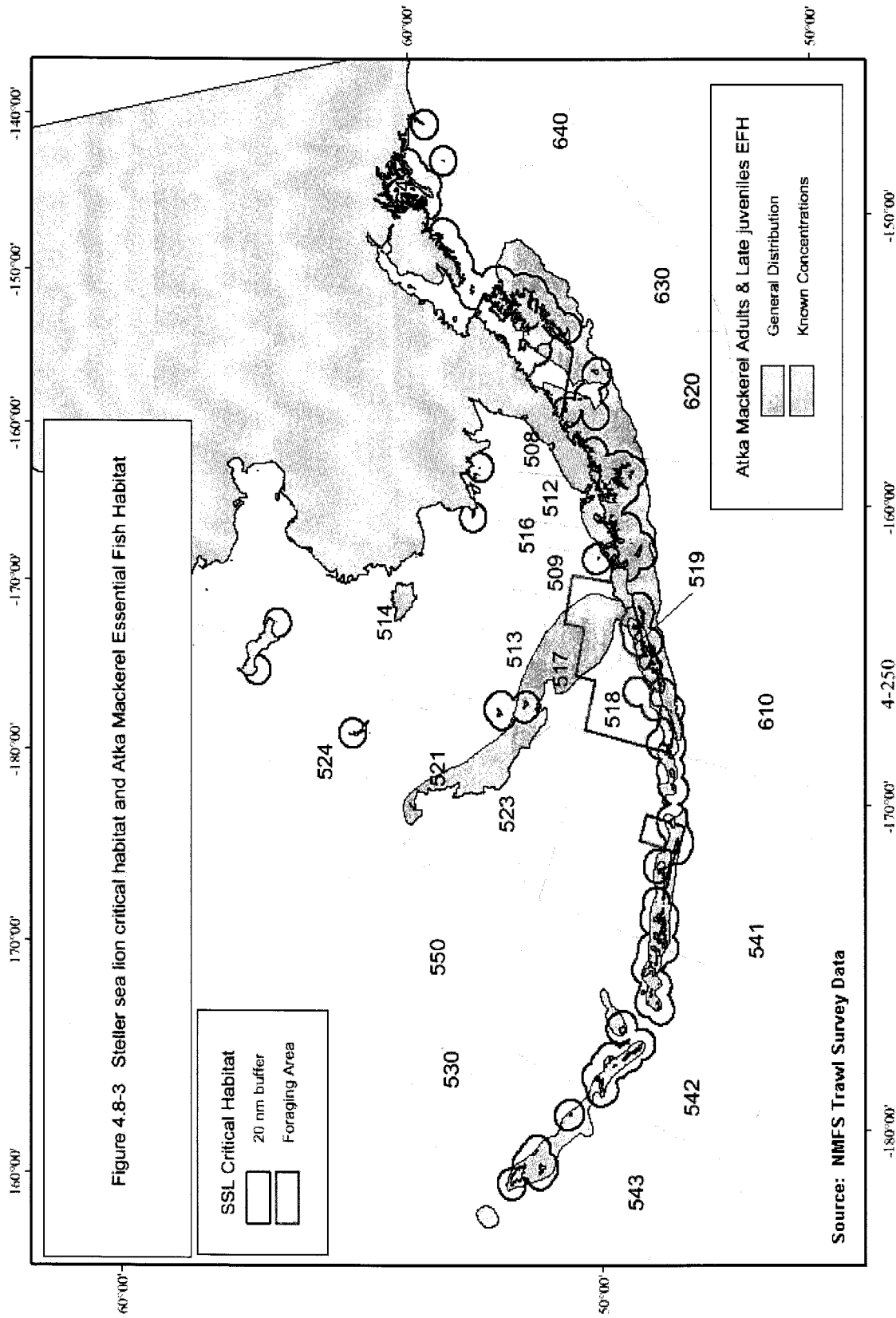


Figure 4.8-3 Atka Mackerel Essential Fish Habitat and Steller Sea Lion Critical Habitat

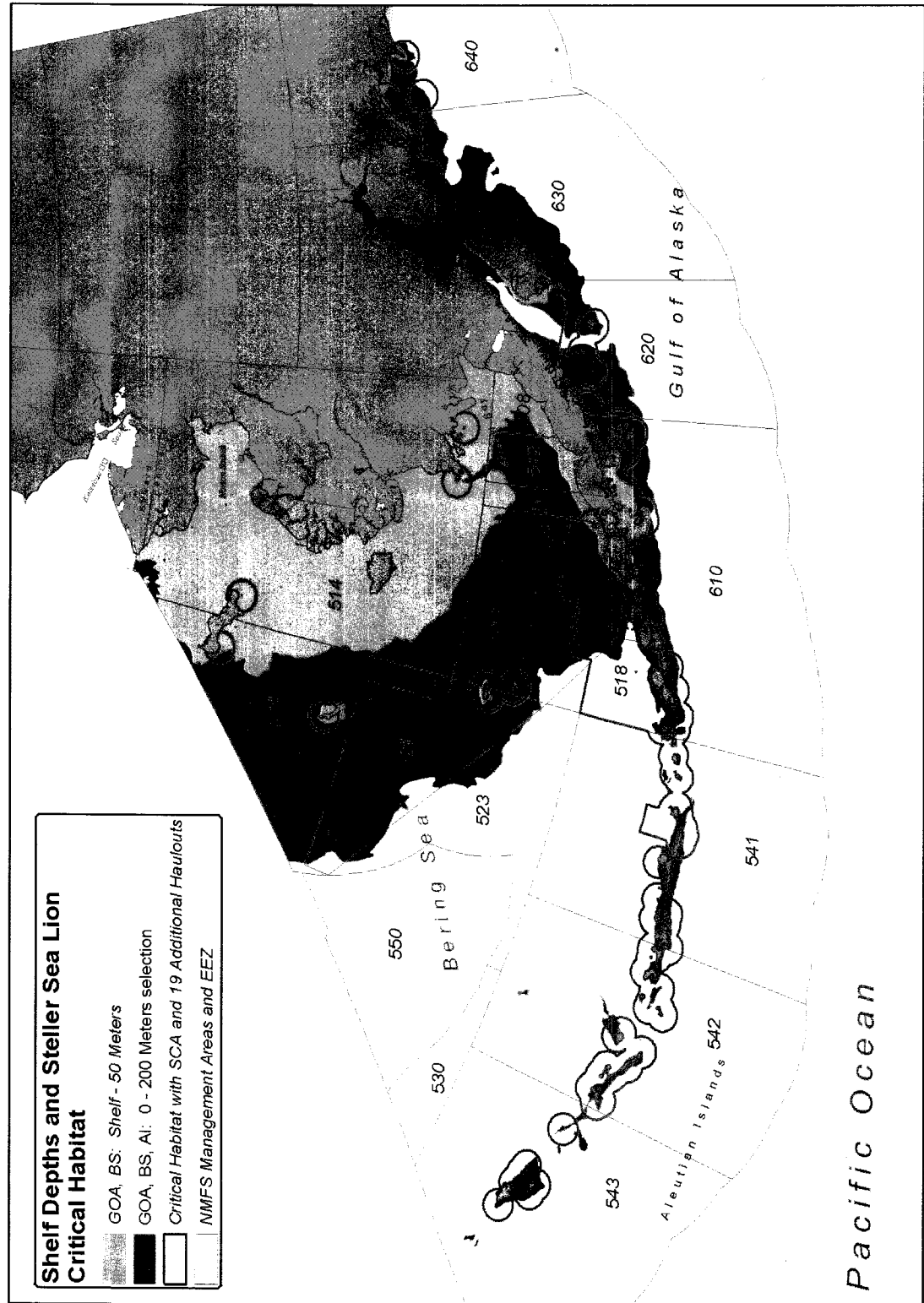


Figure 4.8-4 Shelf Depths and Lion Critical Habitat

Total Closure Areas Under Alternatives 1 - 5

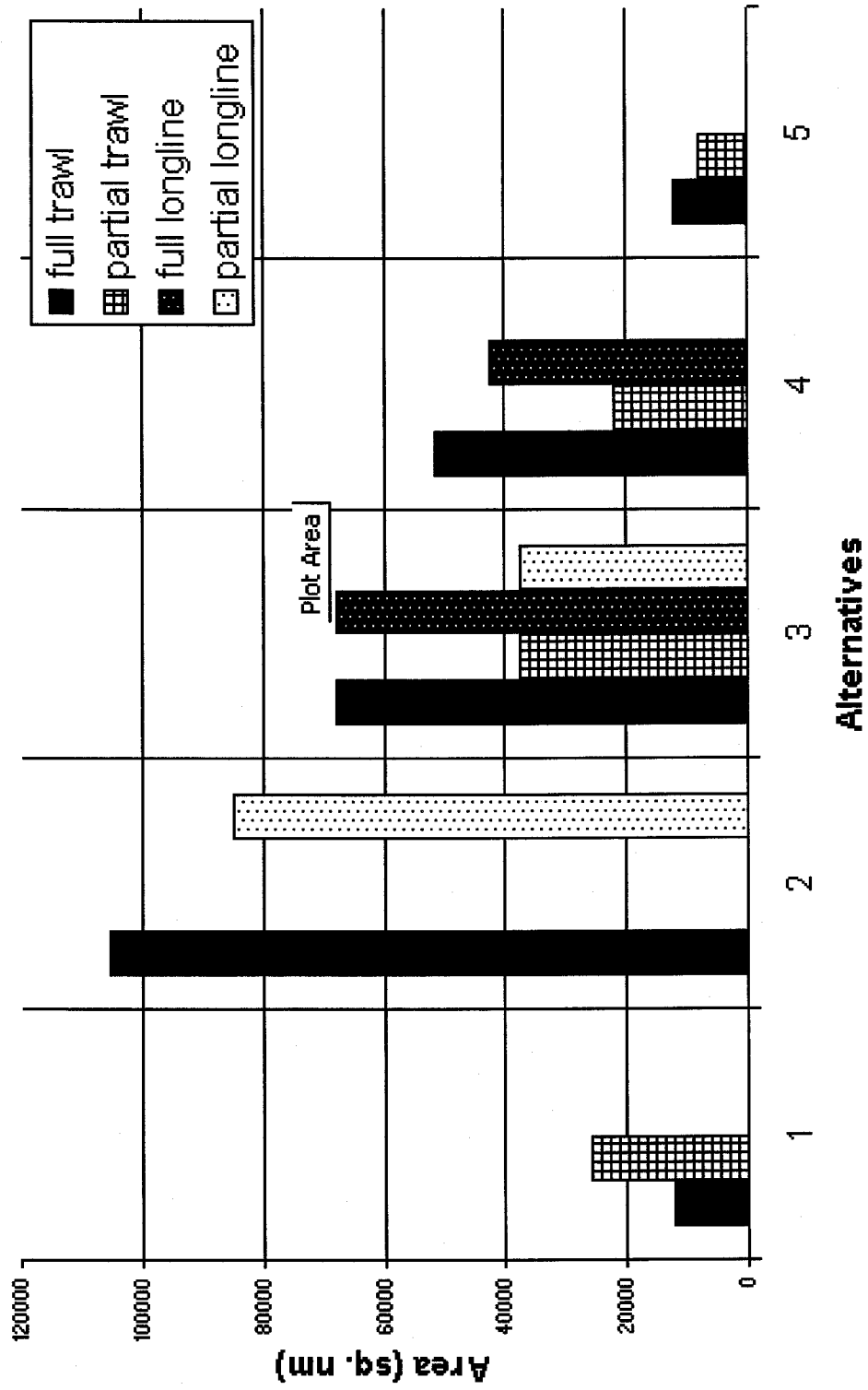


Figure 4.8-5 Trawl Closure Areas under Alternatives 1 - 5

4.9 Effects of the Alternatives on the Ecosystem

In this section, the alternatives are analyzed with respect to various ecosystem-level measures that might indicate the impacts of the alternatives from a broader ecological viewpoint. A review of ecosystem-based fishery management measures implemented for Alaska groundfish fisheries can be found in Witherell et al. (2000). An evaluation of how well the status quo management regime achieves ecosystem-based management objectives is contained in the Draft Programmatic SEIS (NMFS 2001a).

Effects on Predator-Prey Relationships

Fisheries can remove predators, prey, or competitors and thus alter predator-prey relationships relative to an unfished system. Studies from other ecosystems have been conducted to determine whether predators were controlling prey populations and whether fishing down predators produced a corresponding increase in prey. Similarly, the examination of fishing effects on prey populations has been conducted to evaluate impacts on predators. Finally, fishing down of competitors has the potential to produce species replacements in trophic guilds (see reviews of all these effects in Hall 1999). Evidence from other ecosystems presents mixed results about the possible importance of fishing in causing population changes of the fished species' prey, predators, or competitors. Some studies showed a relationship, while others showed that the changes were more likely due to direct environmental influences on the prey, predator or competitor species rather than a food web effect. Fishing does have the potential to impact food webs but each ecosystem must be examined to determine how important it is for that ecosystem. A review of fishing impacts to marine ecosystems and food webs of the North Pacific under the status quo, and other alternative management regimes, was provided in the Draft Programmatic SEIS (NMFS 2001a).

Fishing can selectively remove fish eating predators then move down the food web and begin removing the next trophic level down such as plankton feeding fish. This process is known as fishing down the food web (Pauly et al. 1998). Trophic level of the fish and invertebrate catch from the BSAI, and GOA was estimated from the 1960s to the present (Queirolo et al. 1995, Livingston et al. 1999) to determine whether such fishing down effects were occurring. Trophic level of the catch in all three areas has been relatively high and stable over the last 30 or more years.

Fishing vessels and vessels supporting fishing operations have the potential to disrupt predator-prey relationships through the introduction of nonindigenous species. These introductions occur when ship ballast water containing live organisms is obtained outside a region and is released into fishery management areas. Vessels also have organisms fouling their hulls that can be transported between regions. These organisms have the potential to cause large alterations in species composition and dominance in ecosystems (Carlton 1996).

Effects on Energy Flow and Balance

Fishing may alter the amount and flow of energy in an ecosystem by removing energy and altering energetic pathways through the return of discards and fish processing offal back into the sea. The recipients, locations, and forms of this returned biomass may differ from those in an unfished system. A mass-balance model of the eastern Bering Sea (Trites et al. 1999) provides some information on fishing removals relative to total system production and the distribution of biomass and energy flow throughout the system in recent times. The trophic pyramids (distribution of biomass at various trophic levels) indicate that biomass and energy flow are distributed fairly well throughout the system (Trites et al. 1999, p. 28 of 100). These show that the Bering Sea is a more mature system compared to other shelf systems. A more mature system is one that is less disturbed (Odum 1985). Total catch biomass (including non-groundfish removals) as a percentage of total system biomass (excluding dead organic material, known as detritus) was estimated to be 1%, a small proportion of total system biomass. Fishery removal rates are based in the most basic sense on the amount of surplus production (the excess of reproduction and growth over natural mortality) (Hilborn and Walters

1992) for fish stocks. Because there is great variability among stocks with regard to the amount of this excess production, it is likely more important that removals stay within the bounds of each individual stock's excess production (a topic that is considered in the individual stock impacts sections). From an ecosystem point of view, total fishing removals are a small proportion of the total system energy budget and are small relative to internal sources of interannual variability in production.

Fisheries can redirect energy in the system by discarding and returning fish processing wastes to the system. These practices take energy and potentially provide them to different parts of the ecosystem relative to the natural state. For example, discards of dead flatfish or small benthic invertebrates might be consumed at the surface by scavenging birds, which would normally not have access to those energy sources. An analysis of the importance of these fisheries practices on the BSAI and GOA ecosystems was conducted by Queirolo et al. (1995), before the improved retention requirements for pollock and cod were mandated. Total offal and discard production at that time was estimated at only 1% of the unused detritus already going to the bottom. No scavenger population increases were noted that related to changes in discard or offal production amounts. The annual consumptive capacity of scavenging birds, groundfish, and crab in the eastern Bering Sea was determined to be over ten times larger than the total amount of offal and discards in the BSAI and GOA. Finally, it appeared that the main scavengers of fish processing offal, which primarily consisted of pollock, were also natural pollock predators.

Discard rates dropped even further after the implementation of retention requirements for all pollock and cod in groundfish fisheries. Managed groundfish species discards dropped below 10% of the total catch (down from about 15% in the eastern Bering Sea and Aleutian Islands and 20% in the GOA, respectively) in 1998. The mandated retention of managed flatfish species (yellowfin sole and rock sole in the BSAI and shallow water flatfish in the GOA) in 2003, which make up the bulk of the remaining discards of managed species, may cause the total discard amounts to decrease. Discards are estimated to decline to 7% of the total catch in the BSAI but would remain constant at about 17% of the total catch in the GOA, a reflection of the discard level observed in 1999.

Discards and offal production can cause local enrichment and change in species composition if discards or offal returns are concentrated. Some evidence of those effects have previously been cited (Thomas 1994) in areas with inadequate tidal flushing (Orcas Inlet in Prince William Sound and in Dutch Harbor) but not in the deep water disposal site in Chiniak Bay off Kodiak Island (Stevens and Haaga 1994). Local ocean properties (water flow and depth) and amount of water discharged per year could be important factors determining the effect of nearshore disposal on local marine habitat and communities. Changes to the processing plant at Dutch Harbor dramatically reduced the amount of offal and ground discards discharged. Improved retention could be causing some increases in the amount of local enrichment due to disposal of increased offal from shoreside processing of newly retained fish. However, increase in offal production for the Bering Sea, if all pollock, cod, rock sole and yellowfin sole were to be retained, would amount to an increase of about 6% (NMFS 1996) and would not likely cause a change in water quality.

Effects on Biological Diversity

Fishing can alter different measures of diversity. Species level diversity, or the number of species, can be altered if fishing removes a species from the system. Fishing can alter functional or trophic diversity if it selectively removes a trophic guild member and changes the way biomass is distributed within a trophic guild. Fishing can alter genetic level diversity by selectively removing faster growing fish or removing spawning aggregations that might have different genetic characteristics than other spawning aggregations. Large, old fishes may be more heterozygous (i.e., have more genetic differences or diversity) and some stock structures may have a genetic component (see review in Jennings and Kaiser 1998), thus one would expect a decline in genetic diversity due to heavy exploitation.

The scientific literature on diversity is somewhat mixed about what changes might be expected due to a stressor. Odum (1985) asserts that species diversity (number of species) would decrease and dominance (the degree to which a particular species dominated in terms of numbers or biomass in the system) would increase if original diversity was high, while the reverse might occur if original diversity was low. Genetic diversity can also be altered by humans through selective fishing (removal of faster growing individuals or certain spawning aggregations). Accidental releases of cultured fish and ocean ranching tends to reduce genetic diversity (Boehlert 1996). More recently, there is growing agreement that functional (trophic) diversity might be the key attribute that lends ecosystem stability (see review by Hanski 1997). This type of diversity ensures there are sufficient number of species that perform the same function so that if one species declines for any reason (human or climate-induced), then other species can maintain that particular ecosystem function and less variability would occur in ecosystem processes. However, measures of diversity are subject to bias and how much change in diversity is acceptable is not really known (Murawski 2000).

Localized extinctions due to fishing are rare but some evidence exists that this may have occurred to some skate species in areas of the North Atlantic (see review in Greenstreet and Rogers 2000). These extinctions could be thought of as a decrease in species level diversity or the actual number of species in an area. Elasmobranchs such as shark, skate, and ray species may be vulnerable to fishing removals and direct impacts. No fishing induced extinctions have been documented for any fish species in Alaska during the last 30 years or so. Taxonomic work on some fish species (e.g., skates) is ongoing and minimal survey and systematic work is being done on other ecosystem components, such as benthic invertebrates, that could be impacted by fishing activities.

Diversity may not be a sensitive indicator of fishing effects (Livingston et al. 1999, Jennings and Reynolds 2000). Studies of other more heavily fished systems, such as the North Sea, Georges Bank, or Gulf of Thailand have shown declines in diversity (Hall 1999, Jennings and Reynolds 2000) related to fishing, and the diversity declines were due to direct mortality of target species.

Evidence so far in highly fished areas such as the North Sea suggests that there is little evidence of genetically induced change in selection for body length in cod after 40 years of exploitation (Jennings and Kaiser 1998). Genetic diversity has not been assessed under Alternative 1, but heavy exploitation of certain spawning aggregations can be inferred and heavier exploitation on older, more heterozygous individuals would have the tendency to reduce genetic diversity in fished versus unfished systems. Thus, some change in genetic diversity has possibly occurred in the BSAI and GOA, but the magnitude of the impacts are not known. The North Sea work indicates the impacts might be minimal (Rice and Gislason 1996). Genetic assessment of pollock populations and subpopulations in the North Pacific shows some genetic differences among stocks but has not demonstrated any genetic variability across time within stocks that might indicate fishing influences (Bailey et al. 1999).

Assessment of the Alternatives

For each alternative, the possible impacts are addressed regarding (1) predator-prey relationships, including introduction of nonnative species; (2) energy flow and redirection (through fishing removals and return of discards to the sea); and (3) diversity. Changes seen in the indicators for each alternative were determined to be significant (positive or negative), conditionally significant (positive or negative), or insignificant. In some cases, the predicted changes are estimated qualitatively, and in some cases quantitatively. Table 4.9-1 shows the projected changes in pelagic prey availability and total catch levels for each alternative, and the relative changes are used to assess the impacts of the alternatives on predator-prey relationships and energy flow and balance. Table 4.9-2 lists the indirect effects and describes the criteria used for determining significance of environmental impacts to the ecosystem. Table 4.9-3 shows the determination of significance for the alternatives.

Table 4.9-1 Indicators of biomass change and energy removal for each alternative, using projected biomass and catch (mt/1000) for the years 2001 and 2006 for comparison of projected impacts.

	Alternative 1 (No Action)	Alternative 2 (Low and Slow Approach)	Alternative 3 (Restricted and Closed Area Approach)	Alternative 4 (Area and Fishery Specific Approach)	Alternative 5 (Critical Habitat Catch Limit Approach)
Prey Biomass (mt /1000)					
Bering Sea					
Pollock 2001	10,384	10,384	10,384	10,378	10,378
Pollock 2006	10,233	10,737	10,298	10,271	10,274
Mackerel 2001	704	704	704	700	700
Mackerel 2006	907	984	992	847	838
Gulf of Alaska					
Pollock 2001	886	886	886	889	889
Pollock 2006	1,253	1,437	1,282	1,247	1,247
Prey Biomass 2001	11,974	11,974	11,974	11,966	11,966
Prey Biomass 2006	12,393	13,157	12,571	12,365	12,359
Prey Biomass Percent Change (2001-2006)	3.5	9.9	4.8	3.3	3.3
Catch (mt/1000)					
Bering Sea					
All Groundfish 2001	1,881	1,619	1,649	1,817	1,895
All Groundfish 2006	1,811	1,438	1,502	1,621	1,625
Gulf of Alaska					
All Groundfish 2001	269	186	221	270	271
All Groundfish 2006	305	228	268	331	331
Total Catch 2001	2,150	1,805	1,870	2,088	2,165
Total Catch 2006	2,115	1,666	1,770	1,952	1,955
Total Catch Percent Change (2001- 2006)	-1.6	-7.7	-5.4	-6.5	-9.7

Source: Projected average yields in Section 4.2 of this SEIS.

Table 4.9-2 Criteria for determining significance of effects of the alternatives on predator-prey relationships, energy flow and balance, and diversity.

Issue	Effects	Determination of Significance				
		Significant Adverse (S-)	Conditionally Significant Negative (CS-)	Insignificant (I)	Conditionally Significant Positive (CS+)	Significant Positive (S+)
Predator-prey relationships	1. Pelagic forage availability	Large decrease in total pollock or other key forage abundance (greater than 10%)	Probable decrease in total pollock or other key forage abundance, but magnitude and intensity unknown	No change in total pollock or other key forage abundance (less than 10%)	Probable increase in total pollock or other key forage abundance, but magnitude and intensity unknown	Large increase in total pollock or other key forage abundance (greater than 10%)
	2. Spatial and temporal concentration of fishery impact on forage	Greater temporal and spatial compression of pollock and Atka mackerel fisheries	Probable increased temporal or spatial compression, but degree unknown	Minimal changes to temporal and spatial fishery distributions on key forage (pollock, Atka mackerel)	Probable reduced temporal or spatial compression, but degree unknown	Less temporal and spatial compression of pollock and Atka mackerel fisheries
	3. Removal of top predators	Trophic level of catch relative to trophic level of biomass is higher	Trophic level of catch relative to trophic level of biomass is likely higher, but intensity unknown	No change in trophic level of catch relative to trophic level of biomass	Trophic level of catch relative to trophic level of biomass is likely lower but intensity unknown	Trophic level of catch relative to trophic level of biomass is lower
	4. Introduction of nonnative species	Higher total catch (greater than 10%)	Probable higher total catch > 10%, but intensity unknown	Minimal change in total catch (less than 10% change)	Probable lower total catch more than 10%, but intensity unknown	Lower total catch (greater than 10%)
Energy flow and balance	1. Energy re-direction (discards)	Higher discards (increased more than 10%)	Probable higher discards by more than 10%, but magnitude and intensity unknown	No change in discards (less than 10% change)	Probable lower discards by more than 10%, but magnitude and intensity unknown	Lower discards (reduced by greater than 10%)
	2. Energy removal (catch)	Large increase in total catch (greater than 10%)	Probable increase in total catch by more than 10%, but magnitude unknown	No change in catch removals (less than 10%)	Probable decrease in total catch by more than 10%, but magnitude unknown	Large decrease in total catch (greater than 10% decrease)

Table 4.9-2 Criteria for determining significance of effects of the alternatives on predator-prey relationships, energy flow and balance, and diversity (Cont.)

Issue	Effects	Determination of Significance				
		Significant Adverse (S-)	Conditionally Significant Negative (CS-)	Insignificant (I)	Conditionally Significant Positive (CS+)	Significant Positive (S+)
Diversity	(1) Species diversity	Less stringent policies for the protection of many ecosystem components	Less stringent policies for protection of a few ecosystem components.	status quo policies that protect ecosystem components	More stringent policies for protection of a few ecosystem components	More stringent policies for protection of many ecosystem components
	(2) Functional (trophic) diversity	Increased levels of fishing-induced changes in functional diversity	Probable increased levels of fishing-induced changes in functional diversity, but intensity unknown	Same levels of fishing-induced changes in functional diversity	Probable reduced levels of fishing-induced changes in functional diversity, but intensity unknown	Reduced levels of fishing-induced changes in functional diversity
	(3) Genetic diversity	Increased fishing on spawning aggregations or larger fish	Probable increased fishing on spawning aggregations or larger fish, but intensity unknown	Same levels of fishing on spawning aggregations and larger fish	Probable decreased fishing on spawning aggregations or larger fish, but intensity unknown	Decreased fishing on spawning aggregations or larger fish

Table 4.9-3 Summary of effects of Alternatives 1 through 5 on ecosystem.

Ecosystem	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Predator-prey Relationships					
Pelagic Forage Availability	S+	S+	S+	S+	S+
Spatial and Temporal Concentration	CS-	CS+	CS+	CS+	CS+
Removal of Top Predators	I	I	I	I	I
Introduction of Nonnative Species	CS-	I	I	I	I
Energy Flow and Balance					
Energy Redirection (Discards)	I	I	I	I	I
Energy Removal (Catch)	I	I	I	I	I
Diversity					
Species Diversity	CS-	CS+	CS+	CS+	CS+
Functional (Trophic) Diversity	I	I	I	I	I
Genetic Diversity	I	CS+	CS+	CS+	CS+

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.9.1 Effects of Alternative 1 on the Ecosystem

Predator-Prey Relationships - Most of the work on predator-prey relationships in the BSAI and GOA regions has been done in the eastern Bering Sea. Evidence from modeling studies and examination of trophic guild changes (NMFS 2001a) suggest that there is no clear evidence of fishing as the cause of species fluctuations through food web effects. Multispecies models have shown that although cannibalism can explain a large part of the density-dependent part of the stock recruitment relationship for pollock (that is, the decline in recruitment observed at high spawner biomasses), most of the overall variability in stock and recruitment is not explained by predation (Livingston and Methot 1998). Pollock is a key prey species of many target and nontarget species in the Bering Sea and GOA (Livingston 1989, 1994) and has a central position in the food webs of those ecosystems. Modeling of predation on pollock in the eastern Bering Sea and GOA (Livingston and Methot 1998, Livingston and Jurado-Molina 1999, and Hollowed et al. 2000) shows that different predators may be the most important source of predation mortality during different time periods. For example, Steller sea lion predation on pollock in the GOA was more important in earlier years but the most important current source of predation mortality on pollock is now from arrowtooth flounder. Population levels of some of these predators such as arrowtooth flounder appear unrelated to fishing removals but are more linked to environmental forces that favor the production of these species (Hollowed et al. 1998). Thus Alternative 1 would have insignificant impacts to the ecosystem with respect to removal of top predators. Similarly, the fluctuations observed in species composition of trophic guilds (Livingston et al. 1999) do not appear to be related to fishing removals of competitors or prey, when analyzed at the aggregated level for the whole eastern Bering Sea. Total pollock and mackerel biomass is projected to remain stable in the Bering Sea, but increase by over 40% in the Gulf of Alaska from 2001 to 2006 under Alternative 1. Although the overall total pollock and mackerel biomass was projected to increase by only 3%, the large projected increase in pollock in the Gulf of Alaska under Alternative 1 would have significant beneficial impacts for prey availability.

However, the above analyses did not consider space/time removals of prey by fisheries. Concentrated fishing removals of key prey species in space and time has been of concern in the status quo regime, but under Alternative 1, the space/time closures that have recently been implemented to attempt to remedy the possible effects of these removals on predator species, particularly Steller sea lions would expire. Thus, Alternative 1 would result in a conditionally significant adverse impact regarding the spatial and temporal concentration of fisheries on prey species.

Regarding the potential for ecosystem change through introductions of nonindigenous species, recent work done primarily in Port Valdez and Prince William Sound shows that biological introductions of nonindigenous species has occurred, although these introductions cannot be ascribed to a particular vessel type, such as oil tankers or fishing vessels (Hines and Ruiz 2000). There have been 24 species of nonindigenous species of plants and animals documented primarily in shallow water marine and estuarine ecosystems of Alaska, with 15 species recorded in Prince William Sound. One example of a likely introduction is the predatory seastar *Asterias amurensis*, which is found in other areas of Alaska but has not previously been found in Cook Inlet. These predators have the potential to have a major impact on benthic communities. The extent of impacts remain unknown and unquantified. Therefore, introduction of nonindigenous species by fishing vessels was considered to be a conditionally significant adverse impact on the status quo environment.

Energy Flow and Balance - A mass-balance model of the eastern Bering Sea (Trites et al. 1999) showed that under Alternative 1, total catch biomass (including non-groundfish removals) as a percentage of total system biomass (excluding dead organic material, known as detritus) was estimated to be 1%, a small proportion of total Bering Sea system biomass. From an ecosystem point of view, total fishing removals are a small proportion of the total system energy budget and are small relative to internal sources of interannual

variability in production. Thus, total removals under the no action alternative have a non-significant effect on the environment.

Total offal and discard production prior to 1994 was estimated at only 1% of the unused detritus already going to the bottom (Queirolo et al. 1995). The annual consumptive capacity of scavenging birds, groundfish, and crab in the eastern Bering Sea was determined to be over ten times larger than the total amount of offal and discards in the BSAI and GOA, and the main scavengers of fish processing offal, which primarily consisted of pollock, were also natural pollock predators. Under this Alternative, the largest potential source of energy redirection (discarding) was greatly reduced with the improved retention requirements in the eastern Bering Sea. Combined evidence regarding the level of discards relative to natural sources of detritus and no evidence of changes in scavenger populations that are related to discard trends suggest that Alternative 1 would have non-significant ecosystem impacts through energy removal and redirection.

Diversity - No fishing induced extinctions of groundfish or other marine species have been documented in the last 30 years or so. However, because the sensitive nature of some species considered (i.e., long-lived or low-reproductive potential species, such as skates, sharks, and grenadiers), and the evidence of extinction of related species in the Atlantic, suggests that species diversity could be a conditionally significant adverse impact on the environment under Alternative 1. No fishing-induced changes in functional (trophic) diversity under the current management regime have been detected (NMFS 2001a). Thus, functional diversity was considered to be a non-significant effect on the status quo environment. Genetic diversity changes due to fishing on spawning aggregations or removal of larger fish have not been quantitatively assessed, but because research on more heavily fished areas indicates impacts are minimal Alternative 1 was judged to have a non-significant impact on the environment.

Biomass diversity and evenness for trophic guilds was investigated by Livingston et al. (1999) in the eastern Bering Sea in the current regime (NMFS 2001a). There appeared to be no evidence that groundfish fisheries caused declines in trophic guild diversity for the groups. For example, the biomass of diversity in the pelagic fish consumer guild was close to 1 from 1979 to 1993, a reflection of the dominance of pollock in the biomass of that group. Diversity tended to decline when pollock biomass increased due to large year-class production. Other groups, such as the benthic infauna consumer guild and the crab and fish consumer guild, had higher species biomass diversity than the pelagic fish consumer guild. Guild diversity changes were again seen when a dominant member changed in abundance. The abundance changes of those species were mostly related to recruitment changes and not to fishing. There appeared to be no fishing-induced changes in functional (trophic) diversity in the past under similar fishing practices (Livingston et al. 1999), so under Alternative 1, this was considered to be a non-significant effect on the status quo environment.

4.9.2 Effects of Alternative 2 on the Ecosystem

Predator-Prey Relationships - Alternative 2 has the potential to make fishery-sized cod, pollock, and Atka mackerel more available to predators in time and space through a combination of TAC reduction and spreading the prey removal over time and space. Thus, in the short-term, Alternative 2 would tend to better protect the trophic base of predators, particularly marine mammals, that rely on these prey relative to Alternative 1. Benefits to these predators would result if they encounter some prey limitation in the present regime. In the short term, non-mammal predators that might benefit through increased adult pollock and Atka mackerel include Pacific cod, Pacific halibut, sablefish, and Greenland turbot. Indirect impacts of Alternative 2 could occur by reducing the prey base of other species that compete for food with the Pacific cod, pollock, and Atka mackerel that are not taken. However, there are no indications that food is limiting to these other groundfish species so this indirect effect is likely to be minimal. No large changes are expected in species

composition in the ecosystem due to Alternative 2 because variability in the main species affected (pollock) appears to be more driven by recruitment variability than changes in TAC.

In the long-term, multispecies age-structured predator-prey modeling indicates that when there is decreased fishing on pollock, predators of the smallest sizes of pollock, such as adult pollock and northern fur seal, tend to get more prey (Jurado-Molina and Livingston 2000), but predators of adult pollock may not see this benefit. Increased predation on rock sole, yellowfin sole, and Pacific herring would be predicted by this multispecies forecasting model if Pacific cod were fished at lower rates. Also, when no-fishing scenarios are tested in this multispecies model, the model predicts much lower stock biomasses in the long term than what single-species models predict, particularly for species that are prey in the modeled system, such as pollock, rock sole, and yellowfin sole. Thus, the single-species predictions of increases in pollock biomass when fishing is lowered under Alternative 2 might not be as large in the long term if multispecies considerations are taken into account.

Although Alternative 2 is intended to benefit marine mammals, two key prey species considered (pollock and Atka mackerel) are central prey species in either the pelagic food webs of the BSAI or the GOA. Major increases in key forage species biomass (pollock and Atka mackerel) could potentially benefit the ecosystem due to increased pelagic forage availability. Total pollock and mackerel biomass is projected to remain stable in the Bering Sea, but increase by over 60% in the Gulf of Alaska from 2001 to 2006 under Alternative 2. Although the overall total pollock and mackerel biomass was projected to increase by only 9.9%, the projected increase in pollock in the Gulf of Alaska under Alternative 2 would have significant beneficial impacts for prey availability.

The explicit consideration of spreading out fishery removals of these key prey species in space and time under Alternative 2 results in a conditionally significant beneficial effect to the ecosystem for decreasing the spatial and temporal concentration of fisheries on forage species.

Trophic level of the catch would not be much different from Alternative 1, and little change in the functional species composition of the groundfish community is expected. Thus, trophic level of the catch relative to trophic level of groundfish biomass is about the same, giving Alternative 2 a non-significant impact on the environment with respect to influencing the ecosystem effect of removal of top predators.

If seasonal TAC reductions under the alternatives analyzed translated into fewer fishing vessels or fishing effort for these species, the probabilities for the introduction of nonindigenous species would be reduced. Because the total catch reductions under Alternative 2 would be less than 10%, one would expect a similar level of fishing effort. Thus, Alternative 2 results in a non-significant impact on the ecosystem relative to the potential for introduction of nonnative species.

Energy Flow and Balance - The main impact of Alternative 2 with regard to amount and flow of energy flow in the ecosystem would be to reduce total level of catch biomass removals from groundfish fisheries. This retained energy would consist primarily of catch reductions in pollock, Atka mackerel, and cod. This may provide further ecosystem protection for energy flows that involve these species. Yet catch is thought to represent a small proportion of total ecosystem energy (Queirolo et al. 1995). Alternative 2 may reduce energy removal from the system slightly, but because catch is not projected to decrease by more than 10% Alternative 2 was judged to have a non-significant impact to the environment with regards to energy flow from reduced catch levels.

Discards may be slightly reduced under Alternative 2 relative to Alternative 1, primarily through reductions in the catch, and consequent discards, of flatfish and Atka mackerel. Yet negative impacts of the present discarding practices have not been demonstrated. Additionally, because catch levels are not expected to be reduced by more than 10%, and the level of discarding cannot be estimated due to the complexity of issues involved (changes in markets, prices, etc.), Alternative 2 was determined to have a non-significant impact relative to changes in discarding.

Diversity - Alternative 2 would likely have little change in species level diversity relative to Alternative 1, except that it could potentially help reverse the trend in species decline of Steller sea lion. Thus, Alternative 2 was determined to have conditionally significant beneficial impacts for that reason. Overall biomass diversity of the groundfish complex would not be expected to change relative to Alternative 1 and likely would not change functional relationships among species. Genetic diversity could increase under Alternative 2 if older, more heterozygous individuals were left in the populations of cod, pollock, and Atka mackerel, and fishing were dispersed from nearshore spawning locations of cod and pollock. For this reason, Alternative 2 was determined to have conditionally significant beneficial impacts by reducing fishing mortality and reducing fishing on spawning aggregations.

4.9.3 Effects of Alternative 3 on the Ecosystem

The effects of Alternative 3 on the ecosystem would likely be similar to Alternative 2. Measures that were quantitatively estimated are quite similar to Alternative 2, with differences of less than 10%. For other measures that were not quantitatively estimated, the effects on the ecosystem were deemed by NMFS to be insignificant or to have a conditionally significant beneficial effect.

4.9.4 Effects of Alternative 4 on the Ecosystem

The effects of Alternative 4 on the ecosystem would likely be similar to Alternative 2. Measures that were quantitatively estimated are quite similar to Alternative 2, with differences of less than 10%. For other measures that were not quantitatively estimated, the effects on the ecosystem were deemed by NMFS to be insignificant or to have a conditionally significant beneficial effect.

4.9.5 Effects of Alternative 5 on the Ecosystem

The effects of Alternative 5 on the ecosystem would likely be similar to Alternative 2. Measures that were quantitatively estimated are quite similar to Alternative 2, with differences of less than 10%. For other measures that were not quantitatively estimated, the effects on the ecosystem were deemed by NMFS to be insignificant or to have a conditionally significant beneficial effect.

4.9.6 Summary of Effects of the Alternatives on the Ecosystem

The no action alternative was judged to have non-significant effects on the ecosystem for most indicators, but was judged to have a conditionally significant adverse effect on spatial and temporal distribution of the fishery, introduction of non-indigenous species, and species diversity. Significant benefits were projected for the increase in prey biomass.

All of the alternatives to the no action alternative would be expected to have similar effects to the ecosystem. Measures that were quantitatively estimated (i.e., projected changes in biomass and catch) are projected to be quite similar for Alternatives 2-5, with differences of less than 10%. For other measures that were not be

quantitatively estimated, the effects on the ecosystem were judged to be non-significant (removal of top predators, introduction of non-native species, discarding, trophic diversity), or have a conditionally significant beneficial effect (spatial and temporal distribution of the fishery, species diversity, and genetic diversity).

4.10 Effect on State Managed Fisheries and Parallel Fisheries

The alternatives being analyzed all contain differing approaches to the management of pollock, Pacific cod, and Atka mackerel fisheries in the BSAI and the Pacific cod and pollock fisheries in the GOA with the principal goal of providing adequate protection for the endangered western population of Steller sea lions. Each alternative addresses four general topics: how to best spread out the fisheries over the fishing year, how to best disperse the fisheries over a greater area, how to best establish ABC and/or TAC levels for the targeted fisheries, and which areas to close to directed fishing.

The state managed fisheries for invertebrates (crab, sea urchin, sea cucumber, scallops), herring, salmon, rockfish, sablefish, and lingcod are not affected by the alternatives being considered for this action. The pollock fishery inside state waters of Prince William Sound (PWS) is also unaffected by the alternatives being considered for this action. The state conducts an annual assessment of the pollock resource within internal waters of PWS which are the basis for determining the PWS Guideline Harvest Level (GHL). The GHL is then split into 3 regions to disperse catch across the sound. Because the state's of an appropriate GHL for PWS is independent of federal ABC levels, unlike the instance of Pacific cod, none of the alternatives would affect the GHL established for pollock in the state managed PWS fishery. The state waters season for Pacific cod in the GOA could be affected by alternatives which alter the manner in which ABC for Pacific cod is determined. The state's GHLs for the Pacific cod fisheries are set at a level of up to 25% of the federal ABC in the GOA. Alternatives which result in a reduction of Pacific cod ABC would reduce the state's Pacific cod GHLs and the TAC available in the combined federal and state waters parallel fisheries proportionately. These impacts are discussed in greater detail below.

The Biological Opinion (Appendix A) finds that the state waters season for pollock in PWS and the Pacific cod in the GOA as they are currently managed do not jeopardize or adversely modify the critical habitat of the endangered western population of Steller sea lions. It is important to note that the federal action considered in the Biological Opinion assumed that management measures designed to protect Steller sea lions in the federal groundfish fisheries would also be adopted by the State of Alaska for the parallel fisheries which occur concurrently in state waters. The Biological Opinion focused on Alternative 4, the area and fishery specific approach developed by the Council's RPA committee and designated as the preferred alternative. For the purposes of this analysis, similar assumptions were made for all other alternatives, so that the management measures contained in each alternative would apply to the parallel fisheries as well, in order for the protection measures to have their full effect. Management authority for fisheries within state waters rests with the State of Alaska. Implementation of new conservation measures within state waters would require regulatory action by the state. The Board of Fisheries is scheduled to hear this issue November 13-14, 2001. If the State of Alaska concludes that a state fishery is reasonably likely to have a significant negative effect on Steller sea lion foraging, ADF&G intends to pursue action to appropriately modify the fishery.² The Alaska Steller Sea Lion Restoration Team however was not able to find convincing evidence to support the

²Letter from Frank Rue, Commissioner for the Alaska Department of Fish and Game to James Balsiger, Regional Administrator, Alaska Region, NMFS regarding plans to protect Steller sea lions, manage state fisheries, and comply with state and federal laws. May 18, 2001. National Marine Fisheries Service, P.O. Box 21668, Juneau, Alaska 99802.

proposed nutritional stress hypothesis although they did support some near term precautionary measures (Kruse *et al.* 2001).

The effects of each alternative were analyzed for their impact on harvest levels during state waters parallel fisheries, and on levels of participation by vessel gear type and length. Temporal and spatial fishing patterns are discussed in Section 2.5.2 of this SEIS with data provided in Tables 2.5-10 and 2.5-11. Table 4.10-1 summarizes some of the information presented in Tables 2.5-10 and 2.5-11 after deducting harvests of pollock and Pacific cod which occurred in the state waters groundfish fisheries in the GOA during 1999.

These amounts are 2,348 mt of pollock harvested by trawl gear in PWS, 12,398 mt of Pacific cod harvested by pot gear in the GOA, and 1,531 mt of Pacific cod harvested by jig gear in the GOA. No adjustments were necessary for the groundfish fisheries in the BSAI or for trawl and hook-and-line gear in the Pacific cod fisheries in the GOA, as these gear types are prohibited in the state waters season. The results presented in Table 4.10-1 are estimates of catch which occurred during the parallel fisheries in 1999 within 3 nm of listed haulouts and within all state waters (rookeries are closed). In the parallel fisheries it is assumed that the same proportion of fish were harvested within 3 nm of haulouts occurred (Table 4.10-1) as in all fisheries combined; state waters, parallel, and federal (Table 2.5-10). For example in Table 4.10-1 the Pacific cod harvest by pot gear in the GOA in 1999 within 3 nm of haulouts during the parallel fisheries is estimated as 7.4% (1,151 mt) of the total pot gear catch for that year by excluding harvests by pot gear in the state waters season. Estimates of Pacific cod harvests within state waters during the parallel fisheries (6,038 mt) in 1999 are made by excluding harvests by pot gear in the state waters season and represent 38.8% of the total pot gear catch in the combined federal and parallel fisheries in 1999. The fraction of a gear type's harvest in a particular fishery, expressed as a percentage, within 3 nm of haulouts or within state waters, can be interpreted as that gear type's relative reliance on fishing operations in those areas while the amounts harvested, expressed in mt, can be interpreted as a measure of the magnitude of fishing operations in those areas. For example in the BSAI vessels using jig gear for Pacific cod are reliant upon operating within state waters (56.4 % of their total harvest) yet the magnitude of these operations (112 mt) is very low. Greater detail by management area and vessel size are in Tables 2.5-10 and 2.5-11. Because state waters are defined as 0-3 nm from shore and rookeries and haulouts cover most of the shoreline, almost all state waters are inside Steller sea lion critical habitat by default, therefore, the majority of fishing in the parallel fisheries occurs in areas designated as critical habitat for Steller sea lions. For this reason in the analysis of impacts on harvest levels of groundfish in the parallel fisheries, total catch in state waters is used as a proxy for the consideration of impacts which could be expected to result from the implementation of alternatives which include limitations on harvests within Steller sea lion critical habitat.

Table 4.10-1 Federal TAC harvested within 3 nm of listed Steller sea lion haulouts and within all state waters during parallel fisheries in 1999 by area, fishery, gear type, and vessel type.

Area	Fishery	Gear	Vessel Type	Within 3 nm of SSL Rookeries and Haulouts During Parallel Seasons	Within all State Waters During Parallel Seasons
GOA	Pollock	Trawl	CV	1.5% (1,361 mt)	31.9% (29,380 mt)
	Pacific cod	Trawl	CV	0.9% (296 mt)	8.2% (2,696 mt)
		H&L	CV	5.3% (369 mt)	37.1% (2,584 mt)
		H&L	CP	0% (0 mt)	0% (0 mt)
		Pot	CV	7.4% (1,151 mt)	38.8% (6,038 mt)
		Jig	CV	0% (0 mt)	0% (0 mt)
BSAI	Pollock	Trawl	CV	0% (0 mt)	0.2% (1,053 mt)
		Trawl	CP	0% (0 mt)	0% (0 mt)
	Pacific cod	Trawl	CV	0.2% (69 mt)	10.3% (3,554 mt)
		Trawl	CP	0.2% (290 mt)	6.9% (1,001 mt)
		H&L	CP	0.1% (72 mt)	1.4% (997 mt)
		Pot	CV	1.0% (108 mt)	21.6% (2,337 mt)
		Jig	CV	1.5% (3 mt)	56.4% (112 mt)
	Atka mackerel	Trawl	CP	0.3% (155 mt)	0.6% (310 mt)

CV = catcher vessels, CP = catcher processors, H&L = hook-and-line.

Note: Percentage of that gear type's harvest are followed by estimates of catch in mt

4.10.1 Parallel Pacific Cod Fisheries

Alternatives which contain management measures differing from those in effect in 1998 that further restrict Pacific cod fishing by the lowering of TAC, by expanding area closures around rookeries and haulouts, or by imposing catch limits within Steller sea lion critical habitat in the EEZ would also effect harvest levels in the parallel Pacific cod fisheries in state waters during the fishing year.

4.10.1.1 Alternative 1

Under Alternative 1 - No Action, no ABC or TAC adjustments are made and no additional Steller sea lion critical habit area closures or catch limitations from those in effect in 1998. The effects on harvest levels in the parallel Pacific cod fisheries in state waters are insignificant in all areas and for all vessels.

4.10.1.2 Alternative 2

Under Alternative 2 - Low and Slow Approach, ABC levels for Pacific cod in the GOA are set at a level equal to 55% of the maximum permissible ABC and at a level equal to 71.8% of the maximum permissible ABC in the BSAI. In the examples of TAC in Section 2.3 of this SEIS which are based on the most recent GOA and BSAI Safe Reports (NPFMC, 2000c and d) that would amount to a 38% reduction in the TACs for Pacific cod in the GOA and an 18% reduction in the TACs for Pacific cod in the BSAI. Another possible interpretation of the intent of Alternative 2 was that only federal TAC would be set at 55% of the maximum permissible ABC, which would not require the state's GHs for the Pacific cod fisheries conducted in state waters outside of the parallel season to be reduced in proportion.

TAC reductions, the closure of SSL critical habitat to the use of trawl gear, and daily catch limits of 400 mt in the GOA, 600 mt in the Bering Sea, and 600 mt in the Aleutian Islands, would have a significant negative effect on harvest levels in the parallel Pacific cod fisheries within state waters by vessels using trawl gear during the open federal seasons in all areas of the GOA, with the exception of Area 1 (insignificant, because trawl vessels do not target Pacific cod in this area). Vessels using more than 60 pots, and longline vessels greater than 60 feet in length would be prohibited from targeting Pacific cod in parallel fisheries within 10 miles of listed SSL rookeries and haulouts, in combination with daily catch limits and TAC reductions the effect on harvest levels in the parallel fisheries by these vessels is deemed significantly negative in all areas. For vessels using fewer than 60 pots and longline vessels less than 60 feet in length additional closures within 3 nm of listed haulouts would apply along with daily catch limits and TAC reductions. For these vessels the effects are deemed to be conditionally significant negative in all areas except Area 1 (insignificant). For vessels using jig gear, additional closures within 3 nm of listed haulouts would apply along with daily catch limits and TAC reductions. Assuming these vessels could operate outside these areas within state waters in the state waters fisheries, the effect in all areas of the GOA would be conditionally significant negative primarily due to TAC reductions, except for Area 1 (insignificant). In the BSAI the effects on jig gear would be insignificant as only a small portion of jig gear's annual allocation of Pacific cod is normally harvested and reductions in TAC would not have an impact. In the GOA the effects on jig gear would be insignificant as Pacific cod is only minimally harvested in the parallel fisheries and reductions in TAC would not have an impact.

4.10.1.3 Alternative 3

Under Alternative 3 - Restricted and Closed Areas Approach, the application of the harvest control rule, as described in the Biological Opinion dated November 30, 2000, would not affect the ABC for the Pacific cod fishery. Reductions in the Pacific cod ABC would occur when stocks are at levels between 20% and 40% of the estimated pristine spawning stock biomass, but at levels below 20% of the estimated pristine spawning stock biomass directed fishing for pollock would be closed. However in the stock projections for the next five years (Table 4.2-7 of this SEIS), the Pacific cod stocks are not expected to be reduced to levels which would result in ABC adjustments or closures of directed fishing for Pacific cod. Seasonal catch limits inside SSL critical habitat in Areas 3, 5, 7, and 12 and the closure of directed fishing for Pacific cod in Areas 2, 4, 6, 8, 9, 10, 11, and 13 would have a significant negative effect upon harvest levels of Pacific cod in the parallel fisheries in state waters by all vessels. Seasonal catch limits inside SSL critical habitat in Area 1 and by jig gear in all areas of the GOA would have an insignificant effect on the harvest level in this area as these catch limits are not reached during the course of the fishing year.

4.10.1.4 Alternative 4

Under Alternative 4 - Area and Fishery Specific Approach, ABC and GHGs levels are not affected in the Section 2.3 TAC examples in this SEIS. However if in the future the Pacific cod spawning biomass were to decrease below the $B_{20\%}$ level then the directed fisheries would be prohibited and the state's GHGs would be set at 0 mt. Year round and seasonal closures to directed fishing for Pacific cod by vessels using trawl gear within 10 and 20 nm of rookeries and haulouts in Areas 1, 2, 4, 5, 9, 10, and 11 would have a significant negative effect upon harvest levels of Pacific cod by trawl vessels in the parallel fisheries in state waters in these areas. The effect of year round and seasonal closures to directed fishing for Pacific cod by vessels using trawl gear within 10 nm of rookeries and haulouts in Areas 3, 6, 7, 8, 12, and 13 would have a conditionally significant negative effect upon harvest levels of Pacific cod by trawl vessels in the parallel fisheries in state waters in these areas.

Closures to directed fishing for Pacific cod by vessels using fixed gear within 20 nm of rookeries and haulouts in Area 4 and the closure of Area 9 would have a significant negative effect upon harvest levels of Pacific cod by fixed gear vessels in the parallel fisheries in state waters in these areas in the absence of Alternative 4 options 1 and 2. Closures to directed fishing for Pacific cod by vessels using hook-and line gear within 10 nm of selected rookeries and haulouts in Areas 2, 10, and 11 and within 20 nm of selected rookeries and haulouts in Area 12 could have a conditionally significant effect upon harvest levels of Pacific cod by fixed gear vessels in the parallel fisheries in state waters in these areas, if the remaining open portions of these areas could not be as productively fished. The effect of closures to directed fishing for Pacific cod by vessels using pot gear within 20 nm of selected rookeries and haulouts in Areas 10 and 11 is rated significantly negative. The effect of closures to directed fishing for Pacific cod by vessels using fixed gear within 3 nm of selected rookeries and haulouts in Areas 1, 3, 5, 6, 7, 8, and 13 is rated as insignificant as vessels would be largely able to participate in the parallel fisheries elsewhere within the area.

Under Option 1 for Alternative 4, a portion of Area 4 near Chignik, Alaska is opened to vessels less than 60 feet in length using fixed gear to directed fishing for Pacific cod. As the vast majority of vessels that currently participate in the parallel fishery for Pacific cod in Area 4 are under 60 feet in length and use fixed gear, the adoption of this option would change the significant negative rating to insignificant for fixed gear in Area 4. Alternative 4 exempts jig gear in many of these closed areas and is rated insignificant for this gear type in all areas except area 9.

Under Option 2 for Alternative 4, a portion of Area 9 adjacent to Unalaska Island is opened to vessels less than 60 feet in length to directed fishing using jig and hook-and-line (not pot) gear for Pacific cod. The adoption of this option would change the significant negative rating to insignificant for vessels under 60 feet in length using fixed gear in Area 9.

Under Option 3 for Alternative 4, vessels using more than 5 jigging machines, vessels using more than 60 pots, and all vessels using trawl or hook-and-line gear are prohibited from directed fishing for Pacific cod in the GOA in the parallel fisheries. For these vessels the impact on harvest levels of Pacific cod in the parallel fisheries is rated significantly negative in Areas 1, 2, 3, 4, 5, 6, 10, and 11. For vessels using 5 or fewer jigging machines and for vessels using 60 or fewer pots the impact is rated insignificant.

4.10.1.5 Alternative 5

Under Alternative 5 - Critical Habitat Catch Limit Approach, ABC levels and GHs levels are not affected in the Section 2.3 TAC example. However catch limits within Steller sea lion critical habitat in the parallel fisheries could reduce catch by at least 48.2% in the GOA and 76.4% in the Bering Sea and 31.7% in the Aleutian Islands in all areas for all vessels. The effect of Alternative 5 on harvest levels of Pacific cod in parallel fisheries in state waters is rated significantly negative in the GOA and BS, except that seasonal catch limits inside SSL critical habitat in Area 1 in the GOA and jig gear in the GOA and BSAI would have an insignificant effect on the harvest level in this area as these catch limits are not reached during the course of the fishing year. The effect of Alternative 5 on harvest levels of Pacific cod in parallel fisheries for gear other than jig in state waters is rated conditionally significant negative in the Aleutian Islands.

4.10.1.6 Summary of effects and significance ratings

The following criteria were used to describe the potential for significant change in the harvest levels in the parallel Pacific cod fisheries within state waters during the parallel federal seasons. If the alternative is considered likely to increase catch by half it was deemed to have a significantly positive effect (S+). If the

alternative is considered likely to decrease catch by half it was deemed to have a significantly negative effect (S-). If the alternative is considered likely to increase or decrease catch by more than 20% but less than 50% it was deemed either conditionally significant positive (CS+) or negative (CS-). If the alternative is considered likely to increase or decrease catch by less than 20% it was deemed insignificant (I). When insufficient information exists to forecast the effect of the alternative on incidental catch the effect is unknown (U). (Table 4.10-2). These criteria are qualitative in nature, an anticipated increase or decrease in harvest levels of more than 50 % is thought to be a substantial change and is deemed significant. An anticipated increase or decrease in harvest levels of between 20% and 50% may constitute a substantial change and is deemed conditionally significant. It is important to note that although harvest levels in parallel fisheries may be reduced under some alternatives, a particular fishing operation may be able increase harvests outside state waters (possibly medium sized trawl vessels in the Central GOA, Table 2.5-11), while another fishing operation may be extremely reliant on being able to operate within state waters (possibly small sized pot vessels in the Western GOA, Table 2.5-11). An anticipated increase or decrease of less than 20% is deemed insignificant as fluctuations of biomass and TAC levels frequently occur within this range over several years.

The effects of Alternatives 1 through 5 on harvest levels in the parallel Pacific cod fisheries are summarized in Tables 4.10-2 through 4.10-6. The results are an estimate of the range of estimated reductions expressed as a percentage of the total harvest in 1999 in the parallel fisheries by that gear type and in that area. They can be interpreted as the degree of reliance by a particular fishing gear type on participating in the state parallel fisheries.

Table 4.10-2 Summary of effects of Alternative 1 on harvest levels of Pacific cod in the parallel fisheries in the GOA and BSAI.

Area	Trawl	Hook-and-Line	Pot	Jig
1 GOA	I	I	I	I
2 GOA	I	I	I	I
3 GOA	I	I	I	I
4 GOA	I	I	I	I
5 GOA	I	I	I	I
6 GOA	I	I	I	I
7 BS	I	I	I	I
8 BS	I	I	I	I
9 BS	I	I	I	I
10 GOA	I	I	I	I
11 GOA	I	I	I	I
12 AI	I	I	I	I
13 AI	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.10-3 Summary of effects of Alternative 2 on harvest levels of Pacific cod in the parallel fisheries in the GOA and BSAI.

Area	Trawl	Hook-and-Line (vessels < 60 ft)	Pot (vessels < 60 pots)	Jig
1 GOA	I	I	I	I
2 GOA	S-	S- (CS-)	S- (CS-)	I
3 GOA	S-	S- (CS-)	S- (CS-)	I
4 GOA	S-	S- (CS-)	S- (CS-)	I
5 GOA	S-	S- (CS-)	S- (CS-)	I
6 GOA	S-	S- (CS-)	S- (CS-)	I
7 BS	S-	S- (CS-)	S- (CS-)	I
8 BS	S-	S- (CS-)	S- (CS-)	I
9 BS	S-	S- (CS-)	S- (CS-)	I
10 GOA	S-	S- (CS-)	S- (CS-)	I
11 GOA	S-	S- (CS-)	S- (CS-)	I
12 AI	S-	S- (CS-)	S- (CS-)	I
13 AI	S-	S- (CS-)	S- (CS-)	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.10-4 Summary of effects of Alternative 3 on harvest levels of Pacific cod in the parallel fisheries in the GOA and BSAI.

Area	Trawl	Hook-and-Line	Pot	Jig
1 GOA	I	I	I	I
2 GOA	S-	S-	S-	I
3 GOA	S-	S-	S-	I
4 GOA	S-	S-	S-	I
5 GOA	S-	S-	S-	I
6 GOA	S-	S-	S-	I
7 BS	S-	S-	S-	S-
8 BS	S-	S-	S-	S-
9 BS	S-	S-	S-	S-
10 GOA	S-	S-	S-	I
11 GOA	S-	S-	S-	I
12 AI	S-	S-	S-	S-
13 AI	S-	S-	S-	S-

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.10-5 Summary of effects of Alternative 4 on harvest levels of Pacific cod in the parallel fisheries in the GOA and BSAI.

Area	Trawl	Hook-and-Line	Pot	Jig
1 GOA	S-	I	I	I
2 GOA	S-	CS-	CS-	I
3 GOA	CS-	I	I	I
4 GOA	S-	S-	S-	I
5 GOA	S-	I	I	I
6 GOA	CS-	I	I	I
7 BS	CS-	I	I	I
8 BS	CS-	I	I	I
9 BS	S-	S-	S-	S-
10 GOA	S-	CS-	S-	I
11 GOA	S-	CS-	S-	I
12 AI	CS-	CS-	CS-	I
13 AI	CS-	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Options Under Alternative 4, Option 1, the effect on vessels less than 60 feet in length using hook-and-line and pot gear in Area 4 is rated insignificant. Under Option 2 the effect on vessels less than 60 feet in length using hook-and-line, pot, and jig gear is rated insignificant. Under Option 3 the effect on vessels using 5 or fewer jigging machines or 60 or less pots is rated insignificant and significantly negative for all other vessels and gear types.

Table 4.10-6 Summary of effects of Alternative 5 on harvest levels of Pacific cod in the parallel fisheries in the GOA and BSAI.

Area	Trawl	Hook-and-Line	Pot	Jig
1 GOA	I	I	I	I
2 GOA	S-	S-	S-	I
3 GOA	S-	S-	S-	I
4 GOA	S-	S-	S-	I
5 GOA	S-	S-	S-	I
6 GOA	S-	S-	S-	I
7 BS	S-	S-	S-	I
8 BS	S-	S-	S-	I
9 BS	S-	S-	S-	I
10 GOA	S-	S-	S-	I
11 GOA	S-	S-	S-	I
12 AI	CS-	CS-	CS-	I
13 AI	CS-	CS-	CS-	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.10.2 Parallel Pollock Fisheries

Alternatives which contain management measures differing from those in effect in 1998 that further restrict pollock fishing by the lowering of TAC, by expanding area closures around rookeries and haulouts, or by imposing catch limits within Steller sea lion critical habitat in the EEZ would also effect harvest levels in the parallel pollock fisheries in state waters during the fishing year. Pollock is harvested primarily by trawl gear so this analysis focuses on the impacts of the alternatives on harvest levels of pollock by trawl catcher vessels in the GOA and trawl catcher and catcher/processor vessels in the BSAI in the parallel pollock fisheries within state waters.

4.10.2.1 Alternative 1

Under Alternative 1 - No Action, there are no ABC or TAC adjustments, additional area closures or Steller sea lion critical habitat catch limitations from those in effect in 1998 and the effects on harvest levels in the parallel pollock fisheries in state waters are insignificant in all areas and for all vessels.

4.10.2.2 Alternative 2

Under Alternative 2 - Low and Slow Approach, ABC levels for pollock in the GOA are set at a level equal to 44.8% of the maximum permissible ABC and at a level equal to 74.5% of the maximum permissible ABC in the BSAI. In the examples of TAC in Section 2.3 of this SEIS which are based on the most recent GOA and BSAI Safe Reports (NPFMC, 2000c and d) that would amount to a 55% reduction in the TACs for pollock in the GOA and a 2% reduction in the TACs for pollock in the BSAI. Directed fishing for pollock in the Aleutian Islands would be closed year round. Daily catch limits of 1,000 mt in the GOA and 5,000 mt in the Bering Sea, and the closure of SSL critical habitat to the use of trawl gear would have a significant negative effect on harvest levels in the parallel pollock fisheries within state waters during the open federal seasons in all areas of the GOA, except for Area 1 where fishing for pollock does not occur in the parallel fisheries (insignificant). In GOA and BSAI effects on harvests of pollock within state waters by catcher processors are insignificant as these vessels do not participate in the parallel fisheries. In Areas 12 and 13 of the Aleutian Islands effects on harvests of pollock within state waters by catcher vessels are insignificant as directed fishing for pollock was closed in 1999. In Areas 7, 8, and 9 of the Bering Sea the effects on harvest levels by catcher vessels is significantly negative in terms of expected percentage change, however in 1999 only 0.2% (1,053 mt, Table 4.10-1) of catcher vessel's total BSAI catch of pollock came from the parallel fisheries. From the standpoint of reliance upon and magnitude of participation in the parallel pollock fisheries the effects are insignificant.

4.10.2.3 Alternative 3

Under Alternative 3 - Restricted and Closed Areas Approach, the application of the harvest control rule would affect the ABC established for the GOA pollock fishery. Reductions in the pollock ABC would occur when stocks are at levels between 20% and 40% of the estimated pristine spawning stock biomass are unchanged, but at levels below 20% of the estimated pristine spawning stock biomass directed fishing for pollock would be closed. However in the stock projections for the next five years in Section Table 4.2-2 of this SEIS the pollock stocks are not expected to be reduced to levels which would result in closures of directed fishing for pollock. Seasonal catch limits inside SSL critical habitat in Areas 3, 5, 7, and 12 and the closure of directed fishing for pollock in Areas 2, 4, 6, 8, 9, 10, 11, and 13 result in the same estimates of effects as Alternative 2 on harvest levels of pollock in the parallel fisheries in state waters.

4.10.2.4 Alternative 4

Under Alternative 4 - Area and Fishery Specific Approach, area closures to directed fishing for pollock vary from 10 to 20 nm near rookeries and from 3 to 20 nm near haulouts. It is important to note that in some areas these areas overlap closing significantly greater areas of shoreline. In Area 1 of the GOA where trawl vessels do not target pollock in state waters in the parallel fisheries the effect is insignificant. In Areas 2, 4, 10, and 12 of the GOA where closures extend from 10 to 20 nm from all haulouts and rookeries extensive areas within state waters (where pollock fishing has previously occurred) are closed to pollock fishing, these effects are rated significantly negative for harvest levels in the parallel fisheries in these areas. In Areas 3, 5, and 6 of the GOA where closures extend from 3 to 20 nm from all haulouts and rookeries less extensive areas within state waters (where pollock fishing has previously occurred) are closed to pollock fishing, these effects are rated conditionally significant negative for harvest levels in the parallel fisheries in these areas. In GOA and BSAI, effects on pollock harvests within state waters by catcher processors are insignificant, as these vessels seldom participate in the parallel fisheries. In Areas 12 and 13 of the Aleutian Islands effects on harvests of pollock within state waters by catcher vessels are insignificant as directed fishing for pollock was closed in 1999. In Areas 7, 8, and 9 of the Bering Sea, the effects on harvest levels by catcher vessels is significantly negative in terms of expected percentage change, however in 1999 only 0.2% (1,053 mt, Table 4.10-1) of catcher vessels total catch of pollock in the BSAI came from the parallel fisheries. From the standpoint of reliance upon and magnitude of participation in the parallel pollock fisheries the effects are insignificant.

4.10.2.5 Alternative 5

Under Alternative 5 - Critical Habitat Catch Limit Approach, catch limitations of pollock within SSL critical habitat would apply in Bering Sea and directed fishing for pollock in the Aleutian Islands would be closed. In both the BSAI and GOA year round and seasonal closures extend from 10 to 20 nm from rookeries and haulouts. In Area 1 of the GOA effects on harvest levels in parallel fisheries in state waters are insignificant as directed fishing for pollock does not occur in for pollock in the area. In Areas 2, 3, 4, 5, and 6 in the GOA trawl closures around rookeries are less extensive than under Alternative 4 and are seasonal around haulouts. The effect on harvest levels in parallel fisheries in state waters are rated conditionally significant in all areas except in Area 4 where closures occur in areas and at times where state waters are not usually fished for pollock and is rated insignificant. In Areas 10 and 11 the closures are more extensive and are rated significantly negative. In GOA and BSAI, effects on harvests of pollock within state waters by catcher processors are insignificant as these vessels do not usually participate in the parallel fisheries. In Areas 12 and 13 of the Aleutian Islands effects of the closure to directed fishing for pollock within state waters by catcher vessels are insignificant as directed fishing for pollock was closed in 1999. In Areas 7, 8, and 9 of the Bering Sea the effects on harvest levels by catcher vessels is significantly negative in terms of expected percentage change, however in 1999 only 0.2% (1,053 mt, Table 4.10-1) of catcher vessels total catch of pollock in the BSAI came from the parallel fisheries. From the standpoint of reliance upon and magnitude of participation in the parallel pollock fisheries the effects are insignificant.

4.10.2.6 Summary of effects and significance ratings

The following criteria were used to describe the potential for significant change in the harvest level of pollock in the parallel pollock fisheries within state waters during the open federal seasons. If the alternative is considered likely to increase catch by half it was deemed to have a significantly positive effect (S+). If the alternative is considered likely to decrease catch by half it was deemed to have a significantly negative effect (S-). If the alternative is considered likely to increase or decrease catch by more than 20% but less than 50% it was deemed either conditionally significantly positive (CS+) or negative (CS-). If the alternative is

considered likely to increase or decrease catch by less than 20% it was deemed insignificant (I). When insufficient information exists to forecast the effect of the alternative on incidental catch the effect is unknown (U). These criteria are qualitative in nature, an anticipated increase or decrease in harvest levels of more than 50 % is thought to be a substantial change and is deemed significant. An anticipated increase or decrease in harvest levels of between 20% and 50% may constitute a substantial change and is deemed conditionally significant. It is important to note that although harvest levels in parallel fisheries may be reduced under some alternatives, a particular fishing operation may be able increase harvests outside state waters (possibly medium sized trawl vessels in the Central GOA, Table 2.5-11), while another fishing operation may be extremely reliant on being able to operate within state waters (possibly small sized small vessels in the Western GOA, Table 2.5-11). An anticipated increase or decrease of less than 20% is deemed insignificant as fluctuations of biomass and TAC levels frequently occur within this range over several years. A summary of effects on the harvest levels of pollock by trawl gear in the parallel fisheries in the GOA and BSAI is presented in Table 4.10-7.

Table 4.10-7 Summary of effects of Alternatives 1 through 5 on harvest levels of pollock in parallel fisheries by trawl gear in the GOA and BSAI.

Area	Alt 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
1 GOA	I	I	I	I	I
2 GOA	I	S-	S-	S-	CS-
3 GOA	I	S-	S-	CS-	CS-
4 GOA	I	S-	S-	S-	I
5 GOA	I	S-	S-	CS-	CS-
6 GOA	I	S-	S-	CS-	CS-
7 BS CV	I	S-	S-	S-	S-
7 BS CP	I	I	I	I	I
8 BS CV	I	S-	S-	S-	S-
8 BS CP	I	I	I	I	I
9 BS CV	I	S-	S-	S-	S-
9 BS CP	I	I	I	I	I
10 GOA	I	S-	S-	S-	S-
11 GOA	I	S-	S-	S-	S-
12 AI CV	I	I	I	I	I
12 AI CP	I	I	I	I	I
13 AI CV	I	I	I	I	I
13 AI CP	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
CV = Catcher Vessels, CP = Catcher Processors

4.10.3 Parallel Atka Mackerel Fisheries

Alternatives which contain management measures differing from those in effect in 2000 that further restrict Atka mackerel fishing by the lowering of TAC, by expanding area closures around rookeries and haulouts, or by imposing catch limits within Steller sea lion critical habitat in the EEZ would also effect harvest levels in the parallel Atka mackerel fisheries in state waters during the fishing year. In the GOA there is no directed fishery for Atka mackerel, ABC and TAC are set at a gulf-wide level sufficient to allow incidental catch to

be retained in other directed fisheries during the course of the fishing year. Atka mackerel is harvested primarily by large sized catcher processor vessels using trawl gear so this analysis focuses on the impacts of the alternatives on harvest levels of pollock by these vessels in the BSAI in the parallel pollock fisheries within state waters. Beginning in 1998 1% of the Atka mackerel TAC in the Bering Sea and Eastern Aleutian Islands has been allocated to jig gear, however this fishery has not been developed and annual harvests are nominal.

4.10.3.1 Alternative 1

Under Alternative 1 - No Action, there are no ABC or TAC adjustments, additional area closures or Steller sea lion critical habitat catch limitations from those in effect in 2000 and the effects on harvest levels in the parallel Atka mackerel fisheries in state waters are insignificant in all areas and for all vessels.

4.10.3.2 Alternative 2

Under Alternative 2 - Low and Slow Approach, trawling would be prohibited in SSL critical habitat, the TAC for Atka mackerel would be set at 33% of the maximum permissible ABC, and a daily catch limit of 300 mt would be established. In the examples of TAC in Section 2.3 of this SEIS which are based on the most recent BSAI Safe Report (NPFMC, 2000c) that would amount to a 39% reduction in the TACs for Atka mackerel in the BSAI. These management measures would have a significant negative effect on harvest levels in the parallel Atka mackerel fisheries within state waters during the open federal seasons by catcher processor vessels using trawl gear. However estimates of harvests in state waters in 1999 (Table 4.10-1) are relatively low in volume (310 mt) and comprise only 0.6% of these vessels total catch of Atka mackerel. In terms of reliance upon and the magnitude of parallel Atka mackerel fisheries in state waters by catcher processors using trawl gear the effects of Alternative 2 are insignificant. A jig fishery for Atka mackerel has not yet developed (0 mt harvest in 1999) and so the effects on harvest levels by vessels using jig gear is insignificant.

4.10.3.3 Alternative 3

Under Alternative 3 - Restricted and Closed Areas Approach, the application of the harvest control rule would not affect the ABC for the Atka mackerel fishery. Reductions in the Atka mackerel ABC would occur when stocks are at levels between 20% and 40% of the estimated pristine spawning stock biomass are unchanged, but at levels below 20% of the estimated pristine spawning stock biomass directed fishing for pollock would be closed. However in the stock projections for the next five years in Table 4.2-11 of this SEIS the Atka mackerel stocks are not expected to be reduced to levels which would result in ABC adjustments or closures of directed fishing for Atka mackerel. Seasonal catch limits inside SSL critical habitat in Areas 7, and 12 and the closure of directed fishing for Atka mackerel in Areas 8, 9, and 13 result in the same estimates of effects as Alternative 2, significantly negative for catcher processors using trawl gear and insignificant for catcher vessels using jig gear on harvest levels of Atka mackerel in the parallel fisheries in state waters.

4.10.3.4 Alternative 4

Under Alternative 4 - Area and Fishery Specific Approach, the apportionment of Atka mackerel TAC inside SSL critical habitat would increase to 60% of the total TAC. The Seguam Pass foraging area in Area 12, Area 9, SSL critical habitat east of 178° West longitude would be closed to directed fishing for Atka mackerel. West of 178° West longitude there would be a 15 nm closure around Buldir, 10 nm closures around other rookeries, and 3 nm closures around all haulouts. These closures would result in a significantly negative effect on harvests levels of Atka mackerel by catcher processors using trawl gear in the parallel fisheries in

state waters. As vessels using jig gear do not participate in the parallel fisheries the effect on these vessels would be insignificant.

4.10.2.5 Alternative 5

Under Alternative 5 - Critical Habitat Catch Limit Approach, trawling for Atka mackerel would be prohibited within 10 or 20 nm of rookeries and within SSL critical habitat harvest would be limited to 40% of the annual TAC. These closures are far less extensive than under Alternatives 2, 3, and 4 and result in an insignificant effect on harvest levels in parallel Atka mackerel fisheries in state waters for all vessels.

4.10.3.6 Summary of effects and significance ratings

The following criteria were used to describe the potential for significant change in the harvest level of Atka mackerel in the parallel fisheries within state waters during the open federal seasons. If the alternative is considered likely to increase catch by half it was deemed to have a significantly positive effect (S+). If the alternative is considered likely to decrease catch by half it was deemed to have a significantly negative effect (S-). If the alternative is considered likely to increase or decrease catch by more than 20% but less than 50% it was deemed either conditionally significantly positive (CS+) or negative (CS-). If the alternative is considered likely to increase or decrease catch by less than 20% it was deemed insignificant (I). When insufficient information exists to forecast the effect of the alternative on incidental catch the effect is unknown (U). These criteria are qualitative in nature, an anticipated increase or decrease in harvest levels of more than 50 % is thought to be a substantial change and is deemed significant. An anticipated increase or decrease in harvest levels of between 20% and 50% may constitute a substantial change and is deemed conditionally significant. An anticipated increase or decrease of less than 20% is deemed insignificant as fluctuations of biomass and TAC levels frequently occur within this range over several years. A summary of effects on the harvest levels of Atka mackerel in the parallel fisheries in the BSAI is presented in Table 4.10-8.

While some alternatives have a significantly negative effect on harvest levels by catcher processors the amount of catch and reliance upon the parallel Atka mackerel fishery in state waters by these vessels is insignificant. The effect on harvest levels by vessels using jig or other gear is insignificant as they do not presently participate in the parallel Atka mackerel fishery in state waters. None of the alternatives would prohibit the future development of jig fishery for Atka mackerel and if a jig fishery were to develop in the future then reliance upon parallel fisheries in state waters would be expected to be substantial.

Table 4.10-8 Summary of effects of Alternatives 1 through 5 on harvest levels in parallel fisheries in the BSAI.

Parallel Fisheries (Gear/Vessel Type)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Trawl CP	I	S-	S-	S-	I
Jig CV	I	I	I	I	I
All Others	I	I	I	I	I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
CP = Catcher Processors, CV = Catcher Vessels

4.11 Management and Enforcement

This section provides information about the effects of the alternatives on management and enforcement for the groundfish fisheries off Alaska. Each of the alternatives is assessed with respect to the two primary management and enforcement issues: (1) monitoring and enforcing compliance with areas closed to protect Steller sea lions, and (2) managing the commercial harvest of pollock, Pacific cod, and Atka mackerel within specified catch limits. In addition, Section 4.11.3 provides a general discussion of the use of Vessel Monitoring Systems (VMS) to monitor compliance with Steller sea lion protection measures. Section 4.11.4 provides a discussion of the effects of the American Fisheries Act on Steller sea lion protection. A comparison of the alternatives with respect to the two management and enforcement issues is provided in Section 4.11.5.

4.11.1 Monitoring and Enforcing Area Closures

Each of the five alternatives would require closure of some part of Steller sea lion critical habitat area for some or all of the year. Some of these closures would be to all vessels fishing for groundfish, others would be closures to directed fishing for specified species (i.e. pollock, Pacific cod and/or Atka mackerel). These closed areas generally are concentric circles around points associated with rookeries and haulouts or more rectangular shaped areas, such as the Steller Sea Lion Conservation Area (SCA) in the Bering Sea or the Steller sea lion management areas 1 through 13 described under Alternative 3. The boundaries of the critical habitat areas are irregular and the circular areas around rookeries and haulouts often overlap. The larger rectangular areas generally are not consistent with existing NMFS reporting areas (e.g. 521, 541, 620). Although the exact definition of the closed areas differ among the alternatives, they all represent a significant increase in the complexity of monitoring and enforcement of closed areas in the Gulf of Alaska (GOA) and the Bering Sea and Aleutian Islands area (BSAI). Each of the alternatives also involves closure of some areas to directed fishing for a particular species (e.g. pollock, Pacific cod, and/or Atka mackerel). Section 3.11 contains a more detailed explanation of the difficulties of monitoring and enforcing closures to directed fishing.

Alternative 1 would provides the least complex series of fishery closures because it proposes closure of areas from 10 nm to 20 nm around rookeries to all trawling for groundfish. As discussed in Section 3.11, closure of an area to all vessels using a particular gear type is less complex to monitor and enforce than a closure that prohibits vessels from participating in a directed fishery (such as pollock), but allows other directed fisheries to continue in the area. Alternative 1 also includes closure of critical habitat in the Aleutian Islands to directed fishing for Atka mackerel once the critical habitat area catch limit has been reached. However, the directed fishing closures under Alternative 1 are the least comprehensive of any of the alternatives, because they address only one species (Atka mackerel) and two management areas (542 and 543). Alternative 1 would require continuation of the VMS requirements for vessels participating in the Atka mackerel fisheries.

Alternative 2 proposes relatively less complex closures for vessels using trawl gear than the other alternatives, because it would require closure of all Steller sea lion critical habitat areas to all vessels using trawl gear. This provision would not require enforcement officials to determine what directed fishery a vessel using trawl gear was participating in to determine whether the vessel operator was fishing legally within critical habitat areas. However, Alternative 2 does propose a more complex series of closures for vessels using non-trawl gear and directed fishing for Pacific cod. The "zonal approach" would restrict vessels using non-trawl gear and directed fishing for Pacific cod in areas around rookeries and haulouts, as described in Section 2.3.2. This proposal would allow vessels using pot gear (maximum 60 pots per vessel), jig gear, and vessels less than 60' length overall (LOA) using longline gear to fish for Pacific cod between 3 nm and 10 nm of the rookeries and haulouts. All vessels using pot gear or jig gear, all catcher vessels using longline gear, and any

catcher/processor less than 60' LOA using longline gear would be allowed to fish for Pacific cod between 10 nm and 20 nm from the rookeries and haulouts. Vessels using any gear type would be allowed to fish for Pacific cod outside of 20 nm from the rookeries and haulouts. This last provision would allow vessels using trawl gear and catcher/processors equal to or greater than 60' LOA using longline gear to fish only outside of 20 nm from the rookeries and haulouts.

While the zonal approach differentiates the open areas for vessels fishing for Pacific cod by vessel characteristics that could be identified from the air, this proposal would still allow any vessel that is not using trawl gear to fish between 3 nm and 20 nm of the rookeries and haulouts in directed fisheries other than Pacific cod (e.g. sablefish, Greenland turbot, rockfish, halibut). Therefore, it would be necessary to determine both the vessels characteristics and the species composition of the catch onboard the vessels to determine whether the operator was complying with closures under the zonal approach. As discussed in Section 3.11, it is difficult for a boarding officer to assess the species composition of the catch onboard a vessel. NMFS logbooks could be revised to allow operators of catcher/processors to more accurately log the location of catch relative to closed areas. Catch offloading requirements may need to be imposed on catcher vessels to ensure compliance with maximum retainable amounts in areas closed to directed fishing for Pacific cod. Alternative 2 also proposes to require VMS on all vessels fishing for Pacific cod within critical habitat. Under this proposal VMS would be required only by vessels directed fishing for Pacific cod while the cod fishery was open. As discussed in Section 4.11.3, this limited VMS requirement would not be sufficient to monitor the complex area closures under Alternative 2.

Alternative 2 also proposes to require observers on all non-trawl Pacific cod fishing vessels fishing in critical habitat. This requirements may be difficult to implement initially as there may be more need for observers than observers immediately available. Jig vessels have also historically been exempt from observer requirements because of smaller size and safety reasons. An observer onboard a vessel can help NMFS improve estimates of the amount and location of catch, and the target species. However, observers on catcher vessels are limited in the information they can collect about total catch weight and species composition due to the fishing operations (sorted or unsorted catch) and tools available for weighing and sampling catch. To date, the Council and NMFS have not required observers on vessels less than 60' LOA due to concerns about safety, cost, and accommodations for the observers. However, the 60' LOA cut-off between observed and unobserved vessels is an arbitrary length established because of the decision to base observer coverage requirements on vessel categories by length. Observer data from vessels less than 60' LOA would contribute greatly to NMFS's information about catch and at-sea discards by this vessel class.

Significant increases in observer coverage requirements may be difficult to implement in the first year or two due to the changes that the requirement creates in the numbers of observers required and the timing of when observers are required - either competing with existing fisheries that need observers or requiring observers at a time of year when they hadn't been required before. An increase in observer deployments could require additional resources in the Observer Program, NMFS Enforcement, and NOAA General Counsel to ensure their ability to manage and support a larger program, depending on the scope of the increase. For instance, timely debriefing of returning observers directly affects observer availability.

Alternative 3 proposes closure of Steller sea lion management areas 2, 4, 6, 8, 9, 10, 11, and 13 to directed fishing for pollock, Pacific cod, and Atka mackerel. In addition, Alternative 3 would establish catch limits inside critical habitat, which would require critical habitat to close to directed fishing for pollock, Pacific cod, or Atka mackerel once these seasonal catch limits were reached. The closures under Alternative 3 include both aspects of enforcement complexity - the boundaries of the area are complex and the closures apply to vessels directed fishing for certain species, but allow fishing in the area by vessels that are fishing for species

other than pollock, Pacific cod, and Atka mackerel. Alternative 3 includes a large number of directed fishing closures associated with seasonal and inside critical habitat area catch limits for all three species and the various industry sectors (AFA, CDQ, gear and vessel allocations of BSAI Pacific cod). These closures to directed fishing are more complex than would occur under Alternative 1, 2, and 5 (but less complex than those under Alternative 4) because the closures under Alternative 3 apply to a number of different Steller sea lion management areas (areas 2, 4, 6, 8, 9, 10, 11, 13), to all three species, include four seasons, and critical habitat area catch limits. Alternative 1 includes directed fishing closures only for Atka mackerel. Alternative 2 applies directed fishing closures only to vessels using non-trawl gear to fish for Pacific cod around rookeries and haulouts. Alternative 5 does not have as many critical habitat area closures or seasonal closures to directed fishing as Alternative 3 or Alternative 4.

VMS would be required to monitor the closures of critical habitat under Alternative 3 (discussed in more detail below in Section 4.11.3.2). In addition, as described in Section 3.11, the recordkeeping and reporting system designed to collect information in logbooks about the species composition of catch onboard a vessel would not provide adequate data to monitor the directed fishing closures under Alternative 3. Logbooks for catcher/processors would have to be revised to require separate logging of product from inside and outside critical habitat areas if directed fishing closures were different in those areas. Compliance by catcher vessels could be checked at the time the vessel offloaded catch, unless they fished in areas with different fishery closures status.

Alternative 4 has the most complex area closures among the five alternatives, particularly for the GOA pollock fisheries and the GOA and BSAI Pacific cod fisheries. For example, for vessels using trawl gear to directed fish for Pacific cod in the Aleutian Islands west of 178° west longitude, the area from zero to ten nm around rookeries is closed until the fishery for Atka mackerel inside critical habitat in the A or B season is closed. At that time, vessels may directed fish for cod outside of three nm from the haulouts and ten nm of the rookeries. Other examples of the area closures under Alternative 4 are described in Section 2.3.4 and illustrated in Figures 2.3-4, 2.3-5, 2.3-6, and 2.3-7 (map packet).

The closures proposed under Alternative 4 would be difficult to clearly communicate to fishermen, enforcement, and management officials. Current recordkeeping and reporting requirements would have to be modified so that catcher/processor logbooks record information about the location where catch onboard was harvested that is consistent with critical habitat closure boundaries. Assessment of compliance with directed fishing regulations for catcher vessels that fish in areas with different fishery closure status would be very difficult without requiring offload of catch before moving to areas with less restrictive maximum retainable bycatch (MRB) amounts, or requiring observers.

Alternative 5 also includes requirements for closure of areas around haulouts to directed fishing for pollock during some or all of the year, and closure of critical habitat to directed fishing for pollock, Pacific cod, and Atka mackerel once critical habitat area catch limits are reach. These closures also present many of the same complexities for monitoring compliance with area closures to directed fishing that are described for the other alternatives, although they are less complex than those proposed in Alternatives 2, 3, and 4.

4.11.2 Groundfish Quota Management

Alternatives 2 through 5 propose changes to the management of the groundfish fisheries in the BSAI and GOA to provide protection to Steller sea lions. These measures affect NMFS's ability to manage the groundfish fisheries because they increase the number of quota categories by creating quotas for more areas, seasons, or sectors (groups of vessels). In addition, some of the alternatives propose new management measures such as

exclusive registration under Alternative 2, or dividing the fleet into "platoons" under Alternative 4. Section 2.3 provides examples of how the TAC limits would be specified under each of the alternatives. For the analysis, the number of quota categories created under each alternative by the area, season, and critical habitat area catch limits proposed, are compared and summarized in Table 4.11-1. The comparisons show that Alternatives 2 and 3 create the most number of quota categories (78 and 76 respectively), followed by Alternative 5 with 52 quota categories, Alternative 4 with 46 quota categories, and Alternative 1 with 27 quota categories. The number of quota categories shown in this table does not include separate quota categories created by further allocations to the CDQ Program, AFA sectors (inshore, catcher/processors, and motherships), allocation to vessel categories for BSAI Pacific cod (gear, vessel type, vessel length), gear allocations for BSAI Atka mackerel (jig allocation in the EAI), inshore/offshore allocations of GOA Pacific cod, or fishery specific allocations of Pacific halibut and crab prohibited species catch limits.

Alternative 1 would not result in significant changes in the complexity of management of the groundfish fisheries, because it proposes less restrictive quota management measures than are currently in place in 2001. It would create two seasons for pollock, make no changes to the management of Pacific cod, and continue the critical habitat area catch limits for Atka mackerel in the Aleutian Islands. It maintains the existing TAC categories by area, except that it does not include a separate Shelikof Strait pollock quota in the GOA.

Alternative 2 contains some fairly complex proposals with respect to groundfish quota management, including a significant increase in the number of quota categories that would have to be managed, decreases in the amount of quota in each category, seasonal exclusive area registration, daily catch limits, and a foraging area catch limit for Pacific cod.

Table 4.11-1 Number of pollock, Pacific cod, and Atka mackerel quota categories created under each alternative

Area/Species	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Bering Sea Pollock	1 Area 2 Seasons (2)	2 Areas - E 170° W - W 170° W 4 Seasons (8)	1 Area 2 Seasons (A/B, C/D) 4 Seasons Inside CH (6)	1 Area 2 Seasons (A and B) Catch Limit Inside SCA (3)	1 Area 2 Seasons (A/B, C/D) 4 Seasons Inside SCA (6)
Aleutian Islands Pollock	1 Area 1 Season (1)	No Directed Fishing for Pollock in ai (0)	1 Area 2 Seasons (A/B, C/D) 4 Seasons Inside CH (6)	1 Area 1 Season (1)	No Directed Fishing for Pollock in Ai (0)
BSAI Pacific Cod	1 Area (BSAI) 1 Season (1)	5 Areas - E 170° W - W 170° W - EAI (541) - CAI (542) - WAI (543) 4 Seasons Foraging Area Catch Limit in SCA (24)	2 Areas (BS and AI) 2 Seasons (A/B, C/D) 4 Seasons Inside CH (12)	1 Area 2 Seasons (A and B) (2)	2 Areas (BS and AI) 2 Seasons (A and B) Catch Limit Inside CH (8)
BSAI Atka Mackerel	3 Areas - BS/EAI (BS/541) - CAI (542) - WAI (543) 2 Seasons CH Catch Limits in 542 and 543 (10)	3 Areas - BS/EAI (BS/541) - CAI (542) - WAI (543) 4 Seasons (12)	3 Areas - BS/EAI (BS/541) - CAI (542) - WAI (543) 2 Seasons (A/B, C/D) each Area 4 Seasons Inside CH in BS/EAI only (10)	3 Areas - BS/EAI (BS/541) - CAI (542) - WAI (543) 2 Seasons CH Catch Limits in 542 and 543 A and B Platoons in 542 and 543 (18)	3 Areas - BS/EAI (BS/541) - CAI (542) - WAI (543) 2 Seasons CH Catch Limits in 542 and 543 (10)

Table 4.11-1 Number of pollock, Pacific cod, and Atka mackerel quota categories created under each alternative (Cont.)

Area/Species	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
GOA Pollock	4 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - W. Yakutat (640) 3 Seasons in 610, 620, and 630 1 Season in 640 (10)	5 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - Shelikof Strait - W. Yakutat (640) 4 Seasons (18)	4 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - W. Yakutat (640) 2 Seasons (A/B, C/D) 4 Seasons Inside CH (24)	4 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - W. Yakutat (640) 4 Seasons (16)	4 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - W. Yakutat (640) 4 Seasons (16)
GOA Pacific Cod	3 Areas - Western GOA - Central GOA - Eastern GOA 1 Season (3)	4 Areas - Shumagin (610) - Chirikof (620) - Kodiak (630) - W. Yakutat (640) 4 Seasons (16)	3 Areas - Western GOA - Central GOA - Eastern GOA 2 Seasons (A/B, C/D) 4 Seasons Inside CH (18)	3 Areas - Western GOA - Central GOA - Eastern GOA 2 Seasons (6)	3 Areas - Western GOA - Central GOA - Eastern GOA 2 Seasons Catch Limits Inside CH (12)
Total Number of Quota Categories	27	78	76	46	52

Note: Number of separate quota categories by area, season, and limits inside critical habitat are in parenthesis at bottom right of each cell.

Following is a discussion of some of the elements of Alternative 2 that would increase the complexity of managing catch within the established catch limits.

Additional Quota Categories: Alternative 2 creates more new quota categories (78) than any of the other alternatives, by dividing existing quotas both by area and season. For example, the Bering Sea pollock quota would be divided into two area quotas one for east of 170° West long. and the second for west of 170° West long. The BSAI Pacific cod quota would be divided into five area quotas for (1) east of 170° West long., (2) west of 170° West long., (3) Eastern Aleutian Islands (541), (4) Central Aleutian Islands (542), and (5) Western Aleutian Islands (543). The Central GOA Pacific cod quota would be divided between areas 620 and 630. Quotas for Atka mackerel in the BSAI and for pollock in the GOA would not be further subdivided by area under Alternative 2.

In addition to creating new area quotas, Alternative 2 also would divide these quotas among four seasons. Some of the seasonal quotas for sectors allocations of Pacific cod would be very small. If Alternative 2 is selected, fisheries managers may recommend specifying annual quotas for sectors with very small seasonal allocations, such as jig gear, hook-and-line catcher vessels, or catcher vessels less than 60' LOA. Several of the seasonal allocations of quota would be too small for NMFS to open a directed fishery. For example, NMFS expects that the following fisheries might not open to directed fishing due to the small quotas: CGOA (630) pollock in the A and B seasons (287 mt), and West Yakutat (640) pollock (275 mt each season).

Alternative 4 requires the rollover of Pacific cod TAC for the BSAI trawl component so that the opportunity to harvest within the trawl component is maximized. The trawl TAC is allocated between the catcher vessel and catcher processor trawl components. Typically, inseason management will need to assess by the end of March or early April whether either the catcher processors or catcher vessels of the trawl component will be unable to harvest their allocation within the season. Because the catchability of the BSAI Pacific cod drops significantly after April, there will be approximately two to three weeks for the inseason manager to decide if the catcher processor or catcher vessels have the capability to harvest the remaining TAC. If it is determined that the capability exists within the trawl component, then the remaining trawl TAC may be rolled over within the trawl component to either catcher processors or catcher vessels. If the capability to harvest does not exist in the trawl component, then the inseason manager will be able to roll the unharvested TAC to another gear component. The time available to make the rollover available will also be shortened by several days to allow for a federal register notice of the reallocation. Because of the short time period between determining the amount of TAC not harvested and the drop in catchability of Pacific cod, it is possible that even with the rollover, the trawl sector may not be able to fully harvest their TAC amount.

Foraging Area Catch Limit: Alternative 2 also would create a foraging area catch limit for vessels using fixed gear in the SCA that would be 10 percent of the exploitable biomass of Pacific cod inside the SCA. In Section 2.3.2, NMFS estimated that this catch limit would range between 17 mt and 61 mt in the four seasons. The proposal did not specify whether or how to allocate the foraging area catch limit among the various fishing sectors participating in the cod fisheries (CDQ, trawl catcher/processors, trawl catcher vessels, vessels using pot or jig gear, and catcher vessels less than 60' LOA) or how closure of the area would apply to the various sectors. However, regardless of how the catch limit would apply to the various vessels types, this amount probably is too small an amount to allow a directed fishery in the area without some kind of limited access or vessel pre-registration. Without further limits, the fixed gear fleet would exceed the foraging area catch limit before NMFS could obtain sufficient data to close the area.

Daily Catch Limits: Alternative 2 proposes daily catch limits to spread out the catch of pollock, Pacific cod, and Atka mackerel, and proposes weekly catch limits or trip limits if daily catch limits cannot be implemented.

Daily catch limits are assumed to mean the maximum amount of a species that could be harvested each day in a particular area by all vessels of any gear directed fishing for the species. However, in analysis of the management and enforcement implications of daily catch limits, NMFS determined that our current fisheries management system cannot support daily catch limits. We do not receive accurate data about catch by each vessel participating in a directed fishery in time to determine whether a daily catch limit has been reached and to prevent further fishing *on that same day*.

Preliminary observer data from observed catcher/processors and motherships currently are transmitted to NMFS once per day and are available within 30 minutes of receipt. Observer data could be obtained more frequently from catcher/processors and motherships by having the observer send data after each haul or set or by establishing procedures for the vessel crew to transmit observer data. However, the trade-offs in the increased time spent transmitting observer data would have to be evaluated against other observer duties. Data from unobserved catcher/processors currently are available during the next weekly reporting period. NMFS could require these processors to report daily or after each haul, if necessary. However, data from catcher vessels delivering to shoreside processors or floating processors are not available until after the catch is delivered to the processor - anywhere from the same day the catch is made to later in the week.

Even if NMFS could determine when a group of vessels had reached a catch limit at some point during a day, we could not issue closure notices in the *Federal Register* fast enough to legally close a fishery. In addition, some of these fisheries include allocations to vessels of different gear types, sizes, or type (catcher vessel versus catcher/processor) that all fish on the same day. Dividing the daily catch limits among these vessel categories would further complicate management and enforcement.

Weekly catch limits may be more feasible than daily catch limits. NMFS currently manages some fisheries that close in less than one week. In these cases, NMFS uses information about the available quota, past participation in the fishery, expected participation, and past catch rates to decide on the number of days the fishery will be open. This decision is made and announced before the fishery opens, so NMFS is not in the position of tracking daily catch, projecting a closure, and issuing a Federal Register notice in a matter of days. Making a correct projection about the number of days to allow a fishery so that catch remains at or below the quota is difficult - sometimes catch in pre-established number of days exceeds the quota and sometimes it is less than the quota.

Daily or weekly catch limits could be implemented by defining a specific group of vessels allowed to participate in a fishery (cooperatives, group quotas, or individual quotas), assigning the group or individual a specific catch limit (daily, weekly, seasonal, or annual catch limit), and holding the group or individual accountable to not exceed the catch limit. This is how NMFS currently manages IFQ and CDQ fisheries and, to some degree, the AFA pollock fisheries. In these fisheries, NMFS does not track catch in-season and close fisheries by notice in the *Federal Register*. Rather, NMFS implements requirements for catch accounting and reporting. For the IFQ and CDQ fisheries, the individual or group is subject to NMFS enforcement action (a penalty) if a catch limit is exceeded. In most cases, the catch accounting and reporting requirements are greater than for the general fisheries managed by NMFS. In the case of the CDQ fisheries, observer coverage requirements also are greater. However, shifting the burden of responsibility for managing catch within a quota to the fisherman offers greater potential for managing small or complex catch limits, provided that adequate catch monitoring data are available to NMFS to verify industry reports and prosecute overages. Daily catch limits probably would require catcher vessels to offload daily to verify catch and weekly catch limits would require offloading at least once a week. Daily or weekly catch limits may require increased observer coverage requirements for catcher/processors to provide independent and verifiable estimates of catch each day or week.

Alternative 2 proposes that trip limits could be used to approximate the outcome of daily or weekly catch limits to disperse catch of a particular species in critical habitat. Trip limits are a maximum amount of fish that can be caught on a fishing trip or the maximum amount that can be onboard a vessel at any time while fishing in an area. They currently exist in two Alaska fisheries managed by NMFS: the 6,000 pound trip limit in the area 4E halibut CDQ fishery and the 300,000 lb trip limit for pollock in the GOA. Trip limits for catcher vessels do not present any new or difficult in-season management or enforcement issues. A specific trip limit would be established for a fishery and catcher vessel deliveries would be monitored to determine whether participating vessels had exceeded the trip limit. However, determining the appropriate amount of the trip limit to accomplish specific objectives of slowing the pace of fisheries is complicated, particularly in fisheries without quota allocations among different gear types and vessel categories, all of whom fish at the same time during some parts of the year. In addition, it is not clear how trip limits would be adapted for catcher/processors.

Seasonal Exclusive Area Registration: Alternative 2 proposes that "seasonal exclusive area registration would be required, such that vessel must register for one fishing area at a time for each pollock, cod, or mackerel season." NMFS interprets this proposal to mean that a vessel owner must register with NMFS each season before they participate in directed fisheries for pollock, Pacific cod, or Atka mackerel. They may register for only one area per species per season. They would be prohibited from participating in a directed fishery for a species in more than one area in a season.

The seasons are: January 20-March 15, April 1-June 1, June 15-August 15, and September 1-December 31.

The areas are the same as those for the TAC categories under Alternative 2:

Pollock: Bering Sea east of 170° W long.; Bering Sea west of 170° W long, Aleutian Islands, WGOA, CGOA (620), CGOA (630), Shelikof Strait, EGOA

Pacific cod: Bering Sea east of 170° W long.; Bering Sea west of 170° W long, Eastern Aleutian Islands (541), Central Aleutian Islands (542), Western Aleutian Islands (543), Western GOA (610), Central GOA (620), Central GOA (630), Shelikof Strait, and the West Yakutat area of the Eastern GOA (640).

Atka mackerel: Bering Sea/Eastern Aleutian Islands (541); Central Aleutian Islands (542), Western Aleutian Islands (543)

NMFS would be required to establish registration forms, accept registration forms from fishermen, acknowledge receipt of registration (something fishermen have onboard vessel to show compliance with registration requirements), and provide a database of registration information to fishermen and enforcement officers (link up with VMS).

Alternative 3 also would result in the creation of more quota categories (76) and some relatively small quotas. However, Alternative 3 creates new area TACs only for BSAI Pacific cod, by creating a separate BS Pacific cod TAC and AI Pacific cod TAC. The primary impact of Alternative 3 in creating new quota categories is that it proposes seasonal allocation of all pollock, Pacific cod, and Atka mackerel TACs, and seasonal catch limits inside open critical habitat for all areas and species. Based on the examples using 2001 TACs described in Section 2.3, some of these critical habitat area catch limits would be too small to allow directed fisheries to open. For example, the catch limits for Central GOA (630) pollock in the A and B seasons (82 mt),

Western GOA (640) pollock all year (164 mt in A and B season and 246 mt in the C and D seasons), and Western GOA Pacific cod (61 mt to 68 mt in the B, C, and D seasons) probably would be too small to open as directed fisheries.

Alternative 4 would create fewer new quota categories (46) than would Alternative 2, Alternative 3, or Alternative 5. It would not create any new quota categories by dividing existing quotas into smaller area quotas, it would remove the separate quota for pollock in Shelikof Strait, and it would create two seasonal allocations, instead of four. In addition, critical habitat area catch limits are proposed only for Bering Sea pollock in the SCA and for Aleutian Islands (542 and 543) Atka mackerel inside critical habitat.

Management of the Atka Mackerel Fishery under Alternative 4: Alternative 4 proposes to change regulations governing the BSAI Atka mackerel fishery by imposing seasons, area fishing restrictions, limits on amounts harvested inside of critical habitat and regulates the rate of removal of Atka mackerel by limiting the proportion of the fleet fishing inside critical habitat.

This alternative maintains two seasons for Atka mackerel, an A and B season beginning January 20 and September 1 respectively. To fish in the Atka mackerel fishery in areas 542 or 543 vessels would be required to register 30 days in advance of the season beginning date. To reduce the removal rate of Atka mackerel inside critical habitat, the registered fleet would be divided at random into two groups. Participation in a group requires each vessel to sign up thirty days in advance of the start date of the season. By registering for those fisheries, the vessel is committed to not fishing in any other groundfish fishery until 14 days after the beginning of the Atka mackerel season. That is, February 3 for the A season and September 15 for the B season. Each group is allowed to exclusively fish in either 542 or 543 critical habitat until the group's proportion of assigned catch is taken. Each group is prohibited from fishing in the alternate critical habitat area until the alternate group's critical habitat apportionment is taken.

Using 2001 TACs, and assuming an even number of participants, each group would be allowed to catch 7,770 mt per season from 542 of which 5,439 could be taken from critical habitat and 6,452 mt per season from 543 of which 4,516 could be taken from critical habitat. If the number of registered participants are uneven, then the amount available would be rationalized based on the number of registrants. For example if nine catcher/processors register, the two groups would have five and four members. Five ninths of the critical habitat limit would be assigned in each area to the larger group and the remainder to the smaller.

With current 'normal' participation of eight catcher/processors, the fleet average is now 1,000 mt/day and the intent of this alternative is that the amount would be cut to 500 mt/day per area. Critical habitat harvest limits also would be increased from 40% of the seasonal allocation to 60% based on the percentage of Atka mackerel habitat inside and outside critical habitat. Allowing the fishery to occur in an area where Atka mackerel are more concentrated is expected to reduce rockfish bycatch. In recent years the Atka mackerel fishery has been closed on two occasions to prevent overfishing of sharpchin/northern rockfish. In another instance bycatch of shorttraker/roughey rockfish in this fishery contributed to a closure to prevent overfishing of that rockfish group which included the Atka mackerel fishery and other groundfish fisheries.

The proposal makes several assumptions. One that affects the primary goal of the alternative to reduce removal rates of Atka mackerel in critical habitat is that effort will remain relatively static. Other assumptions that affect the practical management of the fishery are that amounts available within critical habitat and catch rates are consistent, reporting is timely, and that vessels will remain in the critical habitat Atka mackerel fishery until its completion.

The assumption that effort will be consistent with recent years so that the entire fleet will be about eight catcher/processors is reasonable if conditions in the groundfish fisheries remain static. This alternative does not limit the number of vessels that can participate in the fishery, but apportions the effort. There have been Atka mackerel fisheries within the last several years when more than those 'regular' participants have been involved including catcher vessels. If the market for Atka mackerel were to improve either by itself or relative to other species, interest in the species could expand and the number of participants increase to a level where the rate of removal is consistent with the current level of catch that this program seeks to diminish (granted effort would have to double, a level not observed in the recent fishery). Although catcher vessels typically do not participate in this fishery, they have done so historically. Alternative 4 does not exclude catcher vessels from the Atka mackerel fishery and their participation could affect the distribution of the TAC between the 2 groups to point where perceived inequities become an issue.

The alternative also assumes a certain parity between the amounts available in each critical habitat and consistent catchability between the two areas. For this proposal to work logistically with the fleet, that is provide near contiguous fishing for an individual catcher/processor, the amounts available within each of the areas needs to be roughly equivalent and the catching rates of the groups consistent so that both fleets complete fishing in each area more or less simultaneously.

Over the last 5 years the allowable catches in 542 and 543 have been as much as 40% different from each other. If the catch rates between the two groups are more or less consistent and one group has 40% more quota to take, the alternate group will be idled. While catcher/processors can fish in the outside critical habitat fishery while the other group completes their critical habitat fishery, if that 'standby' time becomes extended it may not be enough to occupy the group waiting for their opportunity to fish inside critical habitat in the alternate area. The fleet fishing in a 'standby' mode may begin to fish into their critical habitat limit and lose the advantage of reduced rockfish bycatch.

The assumption that catch is consistent affects the accuracy of the projections that will close the fishery. NMFS will project total catch for a particular group's inside limit from one to four days in advance based on the opportunity the agency has to file the closures in the *Federal Register*. Projecting the closure date imposes the potential that each group's portion of the seasonal allocation of the TAC will be either exceeded or under harvested. For example, a recent Atka mackerel fishery for a seasonal TAC apportionment had a goal of about 6,600 mt. In retrospect we know the fishery had daily catch estimates that peaked at 1,200 mt, averaged 830 mt, and had a minimum of 560 mt. Based on inseason data it was decided that the fishery was to close in nine days. Ninety two hundred metric tons were taken. If the 6,600 mt can be thought of as a group allocation of 50 percent of a hypothetical critical habitat fishery, then the second group would be limited to 39 percent fewer fish. If their allocation were originally 6,600 mt, they would be limited to about 4,000 mt. Conversely, quotas have been under harvested as effort has been made by inseason management to avoid catch beyond the quota, this can often leave a day or more catch in the water either for the next group or simply uncaught. In the same district referred to above, during the second season, 1,900 mt were left unharvested, the fishery realizing 88 percent of the allowable catch.

If a 'clean up fishery' is allowed, additional delays are incurred while data are compiled and openings and closures are filed (which under this proposal may increase the delay for the alternate group to enter the critical habitat fishery). The potential also exists that a separate registration process would be required to determine expected harvest capacity for the clean-up fishery. This may be an important consideration given that clean up fisheries also increase the risk of exceeding the overall limit because the amounts available are small and the effects of variable catch exacerbate difficulties in taking the specified amount. These types of problems managing small discrete quotas on an inseason basis illustrate the potential to increase the frustration for the

participants, especially as the agency makes conservative closures to ensure that the catch remains at or below the critical habitat limits.

Alternative 4 assumes consistent and accurate catch reporting from the vessels and their observers. Experience has shown that for whatever reason, e.g. illness on the part of the observer, or equipment failures either on board the vessel or elsewhere in the transmission process, catch reports may be 70 percent complete at the moment a decision has to be made to close a fishery. This issue serves to exacerbate the closure projection problems outlined above. To some degree the accuracy and consistency of reporting of Atka mackerel catch and bycatch of other species can be relieved by observance of each haul which could require two observers on each vessel. There is also the potential to use the vessel monitoring system to transmit limited amount of information to improve the timeliness of data transmission.

The intention of the 14 day stand down is to discourage speculative entry into the fishery. It also ensures that membership of the two groups remains constant. If membership in the groups remain constant the harvest rates and expectations regarding closure dates are more predictable which is important for planing catcher/processors logistics. However, 14 days may not cover the time necessary to harvest the critical habitat limits.

For example, in 2001 542 critical habitat area closed 13 days after the A season opened. In 2000 the same fishery was open 24 days during the A season. In 543 critical habitat was open 24 days in 2001, in 2000 that district was open 62 days. The implication of these time frames is that it takes a longer period to harvest the critical habitat limit than that envisioned in the alternative. If vessels are allowed to abandon the fishery, the duration of the time required for one group to catch their portion of the inside critical habitat limit may be extended which could delay the time the second group is allowed to enter.

What the dates also demonstrate is that the fishery in recent years is not typically one that attracts consistent focused effort which will be necessary for this proposal to work. Catcher/processors have moved in and out of the fishery as opportunity is provided in alternate fisheries including trawl Pacific cod and flatfish. The increased proportion of seasonal TAC allowed to be taken inside critical habitat may attract more consistent effort. However in 1999 when the critical habitat limit in 543 was 80%, the critical habitat fishery did not close before the end of the season on November 1.

Given that the stand down of 14 days doesn't encompass the 'normal' time it takes to take the inside critical habitat limits, some members of the groups may focus on alternate fisheries after the 14 days have passed. The shift in effort out of the Atka mackerel fishery would disrupt the balance of the group thereby reducing its catching capacity and impeding the ability of the alternate group to start fishing.

Most important the alternative addresses issues concerned with localized depletion. It cuts the expected rate of catch inside critical habitat by half. The proposal allows fishing in areas where Atka mackerel are more concentrated which is likely more efficient for the fleet and will reduce bycatch of rockfish in the fishery. However the implementation of this proposal is likely to incur increased logistic problems within the fleet and frustrations on the part of the catcher/processors as they work to maximize the individual vessel's interest. Some of those problems can likely be ameliorated by 'tuning' the alternative. Given the management tools available to the agency, conservative closures directed at ensuring catch inside critical habitat is not exceeded are likely to result in significant portions of the allowable harvest un caught. The increased logistic problems for the fleet and reductions of their expected harvest may be 'worth it' for the fleet given that in 2002, under current management regulations (Alternative 1) the fishery will be limited to 40 percent of their catch from inside critical habitat.

Currently the Atka mackerel fishery in the Central and Western Districts require potentially 10 inseason actions in a year, assuming that all limits and seasonal allocations are taken. Under this alternative 18 actions will be required, not including at least two *Federal Register* notices per season to open the rolls for registration and to notify the fleet of group assignments. The level of attention required by inseason management staff would increase substantially not simply by expansion of the number of inseason actions by also by increased attention to management of data and monitoring and interacting with the fleet.

Alternative 5 would create 52 new quota categories, primarily through the separation of the BSAI Pacific cod TAC into a BS TAC and an AI TAC. In addition, Alternative 5 creates seasonal catch limits inside the SCA and critical habitat for pollock, Pacific cod, and Atka mackerel.

4.11.3 Vessel Monitoring System Requirements

4.11.3.1 Background

Traditional methods to monitor compliance with Steller sea lion area closures include periodic Coast Guard overflights and Coast Guard cutter operations. These methods do not fully meet the NMFS's need to monitor fishing activities in and around Steller sea lion rookeries, haulouts, and areas designated as critical habitat for the following reasons:

- The coverage area is quite large. Protected rookeries, haulouts, and critical habitat areas cover approximately 355,834 square kilometers in the Bering Sea, Aleutian Islands, and GOA (NMFS 2000 Biological Opinion).
- Overflights and cutter patrols serve as spot-checks only. Overflights are sporadic and are effective only during daylight hours when weather conditions are favorable. Visibility is a critical factor in identifying specific vessels from the aircraft. In 2000, Coast Guard aircraft spent approximately 720 hours patrolling Steller sea lion rookeries and haulouts in the BSAI and GOA.
- Cutter operations occur over a broader time frame but they are limited in how much area they can cover. In 2000, a total of 560 cutter days were spent patrolling the BSAI and GOA.
- Coast Guard overflights and cutter patrols serve multiple purposes. Fisheries compliance, search and rescue operations, and international boundary monitoring all share the same platform. Budgetary constraints and other critical missions impact how much time the Coast Guard can actually spend monitoring Steller sea lion closure areas.

NMFS-certified groundfish observers are present on a portion of the vessels that target pollock, Pacific cod, and Atka mackerel. Coverage levels vary according to the size and type of vessel; vessels greater than 125' LOA require 100% observer coverage, vessels 60' to 124' LOA require 30% coverage, and vessels less than 60 feet LOA are exempt from observer coverage. Observers do not play a direct compliance role, their duties are to collect biological data on the fish and invertebrates harvested by commercial groundfish vessels. The data they collect on fishing locations are based on what the vessel operator records in their logbooks and these data are not available in real-time. The accuracy of positions recorded in vessel logbooks cannot be verified by the observer. In addition, logbooks only record haul/set deployment and retrieval location, and even if accurate, are not sufficient to account for vessel activity near a closed area boundary because they provide no information on the vessel position between the haul/set deployment and retrieval locations.

4.11.3.2 Vessel Monitoring System

Vessel monitoring systems (VMS) consist of a transmitter, installed on the vessel, and a communications service provider that relays the transmitter's signal to NMFS. The transmitter determines the vessel's position using Global Positioning System (GPS) satellites and automatically transmits the position to the communications service provider. Vessel locations are transmitted several times per hour and the position information is forwarded to NMFS. Each vessel is assigned a unique number and tracking software at NMFS provides vessel name, position, speed, and heading. The VMS transmitters are designed to be tamper-resistant and automatic. Vessel personnel will be unable to determine when the unit is transmitting and will be unable to alter the signal or the time of transmission.

Automated operation, tamper-resistance, and data security are essential elements of VMS. The criteria for approval of VMS components were described by NMFS in a proposed rule to require VMS in the Atka mackerel fishery in the Aleutian Islands subarea (65 FR 36810, June 12, 2000). These criteria were based on national standards published in the Federal Register on March 31, 1994 (59 FR 15180). At the present time, one VMS system is approved for use in Alaska, the ArgoNet Mar GE transmitter, for which North American Collection and Location by Satellite, Inc. (NACLS) is the sole communications service provider.

VMS data for groundfish vessels off Alaska are monitored by NMFS in Juneau, Alaska. A system to share these data with the US Coast Guard 17th District will be implemented to insure that the Coast Guard has timely access to the information.

NMFS Alaska Region has implemented computer programming systems that integrate VMS data with observer haul data and with the spatial (Geographic Information System) data defining critical habitat. This system automatically identifies observer-reported catch that is from critical habitat, for use in catch accounting for critical habitat limits.

4.11.3.3 Applicability of VMS to Steller Sea Lion Protection Measures

Management measures in the alternatives include several types of restricted areas and critical habitat harvest limits that require VMS for effective monitoring and management. These include "no-transit" zones, "no-fishing" zones, areas closed to directed fishing, areas where fishing is restricted by gear type or vessel size, and areas with critical habitat catch limits. While VMS alone is not sufficient to effectively implement all of these management measures, VMS is an essential component of monitoring and management for all of these measures.

No-Transit Zones: No-transit zones are areas that vessels are prohibited from entering for any purpose.

VMS can inform NMFS of vessel entry into these zones in near real-time, affording the opportunity to deploy physical enforcement assets for further investigation. Without VMS, enforcement of compliance with no-transit zones would be limited to random sightings by enforcement vessels or aircraft.

No Fishing Zones: No-fishing zones are areas that vessels can enter but cannot fish for groundfish in. VMS provides real-time information on the vessel location, course and speed. VMS data can be used to identify potential violations of the no-fishing restriction, and the real-time nature of the VMS data allows deployment of aircraft or vessels to confirm if fishing is occurring. Without VMS, enforcement of compliance with no-fishing zones would be limited to random sightings by enforcement.

Areas Where Directed Fishing is Prohibited: All of the alternatives propose areas where directed fishing for one or more species is prohibited. Enforcement of a directed fishing prohibition is more difficult than enforcement of a no-fishing zone because the latter can be enforced based on the deployment of fishing gear which is relatively easy to observe. Directed fishing standards pertain to the relative percentages of different species of fish that are retained by the vessel and can only be monitored by detailed examination of the catch.

VMS provides real-time information on the vessel location, course and speed. VMS data can be used to identify vessels that are fishing in an area with a directed-fishing restriction. The real-time nature of the VMS data allows deployment of aircraft or vessels to confirm if directed fishing was occurring. In addition, VMS allows tracking of the vessel back to port, providing NMFS with information on where and when the vessel is likely to land catch which will improve NMFS' ability to monitor the landing for compliance with directed fishing standards. Without VMS, enforcement of compliance with directed fishing restrictions would be limited to random sightings by enforcement vessels or aircraft that would have to be followed up with physical at-sea or offload inspections of retained catch.

Areas With Gear and Vessel Size Restrictions: Some of the alternatives contain restrictions on vessel activity in areas that depend on the vessel size, gear being used, and whether the vessel is operating as a catcher vessel or a catcher-processor. VMS data provide real-time information on which vessels are on the grounds and where they are at. VMS data can be used to deploy aircraft or vessels to ascertain compliance with the gear restrictions. Coupled with registration of gear and operating mode, these VMS data could be used to monitor compliance with these restrictions. For example, under Alternative 2, a 70' vessel is not allowed to fish from 3-10 nm with longline gear, but is allowed to fish in that area with fewer than 60 pots. If NMFS had registration information that identified the gear type being used by the vessel that trip, these VMS data could be used to monitor if the vessel was operating in the correct area for the registered gear-type. A gear and operating mode registration system would be a new reporting requirement. Without VMS, enforcement of these restrictions would be very difficult. Vessel length, gear type (particularly for fixed gear), and operating mode (catcher vessel or catcher-processor) often cannot be determined without boarding the vessel.

Areas With Catch Limits: Some of the alternatives contain limits on catch within certain critical habitat areas. To monitor catch limits, managers need to know which vessels fished in the area and how much fish they caught. VMS data provide real-time information on vessel location, and indicate fishing activity. These VMS data can be matched with observer data or landing data for the trip to determine if the catch is counted against the critical habitat catch limit. Detailed location data from an electronic logbook system could also be used to document fishing locations. Without detailed location data, monitoring critical habitat limits on the harvest of pollock, Atka mackerel and Pacific cod cannot be accomplished using current recordkeeping and reporting programs. Many critical habitat limits are small, making real-time effort information essential for estimating and projecting current harvest rates. Fishery managers need accurate information on fleet activity – how many vessels are currently fishing, and whether they are fishing inside or outside critical habitat. Critical habitat areas have complex boundaries. Fishing may occur very close to critical habitat boundaries, and verifying the location of catch would not be possible without detailed position data.

Catch Accounting Procedures for Critical Habitat Catch Limits

Catch would be counted inside or outside critical habitat as verified by the VMS or electronic logbook data corresponding with the unit of catch accounting that applies to the vessel. For observed vessels, the unit of catch accounting is an individual haul or set. For unobserved vessels, the unit of catch accounting is the fish delivered to a processor at the end of a trip.

If an observed vessel fishes inside critical habitat at any time during a haul or set, the entire haul or set would count against the critical habitat limit. If an unobserved vessel fishes inside critical habitat at any time during a trip, the catch for the entire trip will count against the critical habitat limit.

To ensure that critical habitat limits are not exceeded, directed fishery catch of pollock, Atka mackerel or Pacific cod by a vessel without VMS or electronic logbook data, including any vessels exempted from VMS requirements, would count against the critical habitat limit for the quota management area.

Summary of VMS Application to Steller Sea Lion Protection Measures

VMS is critical to effective implementation of area restrictions contained in the Alternatives 2 through 5. The number of sites and their complexity overwhelm the ability of traditional measures such as U.S.C.G. overflights and cutter patrols to monitor critical habitat closures. When critical habitat areas are closed, NMFS expects that fishing will take place very close to the boundaries of the restricted areas. The boundaries of these areas are complex and ensuring that no fishing is taking place inside critical habitat would be impossible using traditional methods of enforcement. Effective enforcement of these closures will depend on the use of a VMS that automatically and frequently transmits vessel positions to NMFS so that vessels fishing near critical habitat can be monitored in real time.

Critical habitat catch limits cannot be monitored without detailed location data. VMS or electronic logbook data can be used in conjunction with observer data or landing data for critical habitat catch limit accounting. With VMS or electronic logbook data, NMFS could verify that vessels claiming to fish outside critical habitat had not fished inside; and could therefore ensure that critical habitat limits were not exceeded.

4.11.3.4 VMS Operation Requirement

Vessels could be required to operate VMS units at all times they are in the EEZ off Alaska or adjacent State waters; or VMS requirements could apply to specific target fisheries or management areas.

The benefits of a VMS system are significantly reduced with a fishery-specific VMS requirement. Having vessels turning the units on and off because they are required to operate them only in particular areas or while targeting a particular species of groundfish will reduce the effectiveness of the system and increase agency operational costs and complexity. NMFS will not know if a VMS signal ceases because the vessel operator is trying to circumvent the monitoring system, because the VMS unit has failed and needs to be fixed or replaced, or because the vessel has elected to stop fishing in the covered fishery.

Requiring vessels to operate VMS only when they are in a particular fishery or area also presents an entirely new enforcement problem – that is, determining if a vessel that did not have a VMS unit fished in the area or fishery for which the unit was required. Given the complex nature of the areas to monitor, finding a vessel that was without a VMS unit in an area where VMS was required using traditional enforcement means would be virtually impossible.

A checkin report for VMS operation will be needed. The checkin report will inform NMFS of the VMS transponder ID being used by the vessel and inform NMFS of the approximate time that the vessel will begin operations in the area subject to VMS requirements. This will enable NMFS to verify that the VMS system is functioning and that VMS data are being received.

Two currently required reports, the processor vessel checkin report, and the vessel activity report, potentially could be supplanted by the VMS system. If a fishery-specific VMS system was implemented, a VMS

checkout report would also be needed, providing NMFS with information that the vessel was leaving the fishery subject to VMS requirements.

4.11.3.5 Fleet Summary

This section presents information on the number of vessels that would be affected by a comprehensive VMS requirement, or by a VMS requirement that affected vessels in specific fisheries for pollock, Pacific cod or Atka mackerel.

The number of catcher/processors that participated in the 2000 BSAI and GOA groundfish fisheries, by gear type and target fishery and the estimated percent of catch by these catcher/processors is summarized in Table 4.11-2. The information is interpreted as follows.

- A total of 38 trawl catcher/processors participated in all BSAI groundfish fisheries in 2000, all 38 of these catcher/processors participated in at least one of the three directed fisheries (Atka mackerel, pollock, or Pacific cod).
- No catcher/processors participated in the GOA pollock fisheries and Atka mackerel is not a separate directed fishery in the GOA.
- Six trawl catcher/processors participated in the GOA Pacific cod directed fishery. An additional 12 trawl catcher/processors participated in other GOA groundfish fisheries, primarily rockfish and flatfish, but did not participate in the Pacific cod or pollock fisheries. All but one of the 18 trawl catcher/processors that fished in the GOA also fished in the BSAI during 2000.
- Forty-two longline catcher/processors participated in the 2000 BSAI groundfish fisheries. Thirty-nine of them participated in the BSAI directed fishery for Pacific cod. Three additional longline catcher/processors participated in the BSAI sablefish/turbot directed fishery, but did not participate in the BSAI Pacific cod directed fishery (one of these three participated in the GOA Pacific cod fishery). These three longline catcher/processors ranged between 59' and 92' LOA.
- Thirteen longline catcher/processors participated in the 2000 GOA Pacific cod fishery. An additional eight longline catcher/processors participated in GOA sablefish fisheries, but did not directed fish for Pacific cod in 2000. All but one of the 21 longline catcher/processors that fished in the GOA also fished in the BSAI during 2000.
- Nine catcher/processors using pot gear participated in the 2000 directed fishery for Pacific cod in the BSAI. These catcher/processors harvested approximately 1% of the BSAI Pacific cod catch in 2000. One additional pot catcher/processor participated in the sablefish directed fishery, but did not directed fish for Pacific cod for pot gear. However, this vessel also participated in the BSAI Pacific cod fishery using longline gear.
- Five pot catcher/processors participated in the GOA directed fishery for Pacific cod in 2000.

The number of catcher vessels and percent of catch by these vessels based on 1999 ADF&G fish tickets are summarized in Table 4.11-3. In the GOA, Atka mackerel has been closed to directed fishing since 1997 and will likely remain closed in the foreseeable future. In the BSAI, 99% of the Atka mackerel harvested is taken by catcher/processors using trawl gear (Table 4.11-3). There is an annual allocation of up to 2% of the Bering Sea/Eastern Aleutians TAC to vessels using jig gear but no landings were made by vessels in this category in 1999 or 2000.

Table 4.11-2 Number of catcher/processors that participated in the 2000 BSAI and GOA groundfish fisheries, by gear, area, and target fishery and total catch of the target species (Atka mackerel, pollock, and Pacific cod) in the directed fisheries for these species by catcher/processors and catcher vessels delivering to motherships.

Gear	Bering Sea and Aleutian Islands						Gulf of Alaska			Total BSAI and GOA Targets	
	Atka Mackerel		Pollock		Pacific Cod		All BSAI Targets	Pacific Cod			All GOA Targets
	Vessels	Catch	Vessels	Catch	Vessels	Catch	Vessels	Catch	Vessels		
Trawl Catcher/Processors	12	99%	16	39%	26	9%	38	6	2%	18	39
Hook-and-Line Catcher/Processors	0		0		39	47%	42	13	9%	21	43
Pot Catcher/Processors	0		0		9	1%	10	5	2%	5	12

Note: Percent figure (%) represents the percent of 2000 total catch of each species by the processor category in the BSAI or GOA.

The following BSAI catcher/processors also participated in the CDQ fisheries in 2000:

3 trawl catcher/processors for Atka mackerel CDQ

11 trawl catcher/processors for pollock CDQ

14 longline catcher/processors for Pacific cod CDQ

Source: NMFS, Blend 2000.

Table 4.11-3 Number of catcher vessels that participated in the BSAI and GOA groundfish fisheries in 1999, by gear type, vessel length, area, and directed fishery, and the percent of catch of the target species by each catcher vessel category

Gear Type and Length Over All	Bering Sea/Aleutian Islands				Gulf of Alaska				BSAI + GOA Unique Catcher Vessels	
	Pacific Cod		Pollock		Pacific Cod		Pollock		Atka Mackerel Pacific Cod Pollock	Other Fisheries
	Vessels	Catch	Vessels	Catch	Vessels	Catch	Vessels	Catch		
Trawl, <60'	1	<1%	3	<1%	50	18%	27	13%	52	2
Trawl, 60'-124'	63	14%	76	27%	67	31%	78	78%	106	1
Trawl, ≥ 125'	29	5%	29	30%	4	<1%	23	9%	29	0
Hook-and-Line, <60'	2	<1%			73	1%			75	335
Hook-and-Line, 60'-124'	6	<1%			41	<1%			44	66
Hook-and-Line, ≥ 125'					1	<1%			1	0
Pot, <60'	1	<1%			14	4%			14	3
Pot, 60'-124'	48	5%			77	15%			102	10
Pot, ≥ 125'	22	2%			5	<1%			22	0
Jig, <60'	10	<1%			121	2%			129	30
Jig, 60'-124'	1	<1%			1	<1%			2	1
Jig, ≥ 125'					1	<1%			1	0

Percent of catch does not add up to 100% (except for GOA pollock) because catch also was landed by catcher/processors. Includes all catcher vessels for which fish tickets were submitted, including those delivering to motherhips.

4.11.3.6 Cost of VMS

Estimated Cost of VMS: The VMS units cost \$1,800 each, with an additional \$50 for shipping. Installation costs likely will range between \$100 and \$2,000, with an expected average cost of \$400. Annual maintenance costs are estimated at \$200.

The cost of transmitting the required data from the VMS unit is \$5.00 per day. Annual costs of VMS data transmission will depend on the number of days the vessel fishes, which will vary depending on the gear, area, and directed fisheries in which the vessel participates. Table 4.11-4 provides a range of estimates of the number of days fished by catcher/processors in 2000. These estimates are based on assuming that the catcher/processor fished every day during a week for which it submitted a weekly production report (WPR) to NMFS (number of WPRs x 7 days). An estimate of the annual VMS transmission costs for each category of processor vessel is made by estimating the number of days fishing or taking deliveries by \$5.00. The following summarizes the estimated annual VMS transmission cost estimates in Table 4.11-4:

- Annual costs for trawl catcher/processors range from about \$400 to \$1,600 and average about \$1,000.
- Annual costs for longline catcher/processors range from \$140 to about \$1,700, and average about \$1,000.
- Annual costs for pot catcher/processors range from \$70 to \$560, and average about \$280.

Table 4.11-4 Estimated number of days fishing by catcher/processors in 2000 and estimated annual VMS transmission costs for catcher/processors by gear type

Gear Type	Estimated Number of Days Fishing			Estimated Annual VMS Transmission Costs for Each Catcher/Processor		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Trawl Catcher/Processor	77	329	210	\$385	\$1,645	\$1,050
Longline Catcher/Processor	28	343	196	\$140	\$1,715	\$980
Pot Catcher/Processor	14	112	56	\$70	\$560	\$280

Note: VMS transmission costs are \$5.00 per day.

Source: NMFS, Blend 2000

Table 4.11-5 provides a range of annual VMS transmission cost estimates for each category of catcher vessel, by gear and vessel length.

Table 4.11-5 Estimated minimum, maximum, and average number of days fished by each catcher vessel in 1999, and the estimated daily VMS transmission costs per vessel

Vessel Gear Type and Length Over All	Estimated Number of Days Fished in a Year for Each Catcher Vessel			Estimated Annual VMS Transmission Costs for Each Catcher Vessel		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Trawl, <60'	1	63	22	\$5	\$315	\$110
Trawl, 60'-124'	1	219	40	\$5	\$1095	\$200
Trawl, ≥ 125'	6	117	51	\$30	\$585	\$255
Hook-and-Line, <60'	1	120	13	\$5	\$600	\$65
Hook-and-Line, 60'-124'	1	128	25	\$5	\$640	\$125
Hook-and-Line, ≥ 125'	4	12	7	\$20	\$60	\$35
Pot, <60'	1	175	24	\$5	\$875	\$120
Pot, 60'-124'	1	153	25	\$5	\$765	\$125
Pot, ≥ 125'	2	50	27	\$10	\$250	\$135
Jig, <60'	1	79	13	\$5	\$395	\$65
Jig, 60'-125'	1	26	8	\$5	\$130	\$40
Jig, ≥ 125'	1	1	1	\$5	\$5	\$5

Source: 1999 ADF&G fish tickets for all catcher vessels delivering any amount of groundfish. VMS transmission costs are assumed to be \$5.00 per day.

NOAA Funding of VMS: NOAA Office for Law Enforcement (OLE) has stated it would be in their best interest to fund all costs associated with VMS. This includes purchase, installation and operations of a VMS. However, NOAA OLE has no funding at this time for this program. If funding were made available, NOAA OLE would be willing to implement the program. However, absent timely federal funding support, the cost of VMS would be the responsibility of the vessel operator.

4.11.3.7 Alternatives to VMS for Vessel Tracking

Electronic logbooks have been suggested as a backup to VMS or an alternative to VMS. These systems consist of software running on a computer that is interfaced to a GPS unit. The system records position, course and speed data that can be transmitted as a message attachment or copied onto a portable computer media for later submission.

An electronic logbook system differs from a VMS in several ways. The essential characteristics of a VMS system that make it useful as a monitoring and enforcement tool include:

1. VMS units are highly tamper-resistant.
2. Vessel operators are unaware of exactly when the unit is transmitting.
3. Vessel operators are unable to alter the signal or time of transmission.
4. Data are transmitted from the vessel in near-real time.

5. Data are automatically received, processed, and available to fishery managers and enforcement staff within minutes.

An electronic logbook system may not be as tamper-resistant as a VMS, since it would use a commercial GPS unit interfaced to a computer using an industry standard interface. These data are stored on a computer onboard the vessel, which introduces data security issues. Electronic logbook data are not automatically and securely transmitted from the vessel. Electronic logbook data, even if transmitted regularly from the vessel using an email messaging system, would not be as timely as VMS data. Because of these characteristics, NMFS does not find that electronic logbooks can substitute for VMS for monitoring vessel activity in restricted areas.

An appropriately designed and implemented electronic logbook system could meet the needs of documenting fishing activity for the purposes of accounting for critical habitat catch limits. The system would need to ensure that the electronic logbook data were available to NMFS along with the catch data (from observer reports or shoreside landing documents) in a standard format enabling automated matching of electronic logbook position data and the catch data. Also, an electronic logbook that securely recorded accurate vessel positions could serve as a secondary source of information to document vessel location in the event of a VMS system failure.

4.11.4 Effects of the American Fisheries Act on Steller Sea Lion Protection

Implementation of the American Fisheries Act (AFA) in the BSAI pollock fisheries aided vessels participating in that fishery in complying with Steller sea lion protection measures. Many of the regulations adopted for Steller sea lion protection are intended to reduce localized depletion of fish stocks by requiring fishers to temporally and spatially disperse their harvests. The AFA has improved the efficacy of these protection measures. The cooperative program created by the AFA allocates shares in the fishery to participating fishers. Doing so has led to more effective compliance with and monitoring of the Steller sea lion protection measures because each fisher's activity is clearly delineated. In addition, fishers that temporally disperse their harvests do not jeopardize their share in the fishery. The changes brought on by the AFA have made the Steller sea lion protection measures more effective and helped to reduce the cost to fishers of complying with those regulations.

Prior to implementation of the AFA, the BSAI pollock fisheries were regulated by TAC and season length limitations. Under these regulations, each fisher was free to harvest as much of the TAC as desired until the TAC was fully harvested. Season length regulations created an incentive for fishers to harvest fish quickly after the season opening because the fisheries remained open only until the TAC was harvested. The result was a fishery in which harvests were temporally concentrated after the season openings in a race for fish.

An ancillary effect of the incentive to harvest fish quickly was the spatial concentration of harvests. In the pre-AFA fishery, fishers could maximize fishing time and harvests by concentrating their efforts in the most productive fishing grounds that were closest to their processors. Fishing near the processor reduced the time of travel to and from fishing grounds to deliver harvests to the processor, increasing harvest rates and the share of the TAC. Participants in the pre-AFA fishery benefitted from both temporally and spatially concentrating harvests.

On the most straightforward level, the AFA reduced the concentration of harvesting activity by simply reducing the number of vessels participating in the BSAI pollock fishery. One provision of the AFA was a buyback of 9 vessels that permanently removed those vessels from the fleet. The AFA, however, included

other provisions that reduced incentives to concentrate effort easing compliance with the Steller sea lion protection measures.

Unlike the pre-AFA fishery, where a fisher's share of the TAC was not limited, the AFA apportions the BSAI pollock fishery among cooperatives. Each cooperative is provided with a specific share of the TAC, which the cooperative's members are free to harvest at any time during the season. The cooperative's share of the TAC is not affected by the timing of the harvests, so cooperative members are able to harvest at the rate and at the times that provide the greatest return. A few different factors are likely to affect these harvest decisions.

Most important, slowing the race to fish has increased production efficiencies. Prior to the AFA, harvesters tailored their operations to harvest maximum quantities in short periods of time. A fisher's harvest allocation were determined by the rate that fisher could harvest fish, rewarding fishers able to harvest fish the fastest. Under the cooperative system, harvest technologies and effort levels can be set at more economically efficient levels. Instead of adopting a technology to maximize harvest income in a race to fish, harvesters determine harvesting activity to obtain the highest income from a fixed allocation of fish. Under the AFA, vessels can apply the most efficient technologies to their effort rather than determine effort levels and technologies based on the desire to obtain a larger share of the fishery. The relationship to the Steller sea lion measures is evident, as fishers no longer need to concentrate harvests immediately after the season opening to ensure their share of the fishery. Instead, harvests can be dispersed temporally, as required by the sea lion measures, without loss of an interest in the fishery.

Production efficiencies under the AFA are also realized by processors. In the pre-AFA fishery, the concentration of harvests shortly after the season opening led to the concentration of deliveries to processors in those periods. Processors were forced to operate at peak capacity early in each season to handle inputs, then would decrease production later in the season when harvest activity slowed. Under the AFA, temporally dispersing the delivery of harvests has reduced the stress on processing facilities allowing processors to operate at a more efficient level. The cooperative relationship created by the AFA (where several harvesters work primarily with a single processor) contributes to these efficiencies, as harvester inputs can be timed to maintain efficient operations. The benefit processors have realized from the temporal distribution of harvests is evident in the increased utilization rates since AFA implementation. Since deliveries to processors can be timed to develop a more steady flow of fish into plants, processors are more able to focus on improving utilization rather than maintaining operations to keep pace with an accelerated flow of inputs. By reducing the incentive for harvesters to concentrate harvests early in the season, the AFA has increased the role of production efficiencies in dispersing harvests temporally, as required by the Steller sea lion protection measures.

Of lesser importance, market conditions are likely to influence the timing of harvest activity. The distribution of interests among the cooperatives has allowed fishers to time effort and determine effort levels in response to market conditions rather than management decisions such as timing of the season opening. Fishers can time harvests to coincide with high market prices without risk of losing a share of the harvests. Typically, this would imply that harvesters would disperse harvest to ensure that the market is never flooded with product. Oversupply of product to the market reduces revenues to the industry for a few reasons. First, the oversupply of the market tends to drive down the price of products reducing revenues. This is less of a factor in the highly processed pollock fishery than in fresh fish fisheries such as halibut. Second, oversupply often has an attendant carrying cost increase as inventories accumulate in greater quantities and for longer periods of time. In food industries that require refrigeration these inventory costs can be high. Both production technologies and market influences reduce the incentives to concentrate harvests under AFA regulations.

The allocation of shares through cooperatives has also improved compliance with and enforcement of the Steller sea lion measures. Prior to the AFA, harvest of all fishers needed to be monitored daily to ensure that

the closure of the fishery was timed with the harvest of the complete TAC. The division of the TAC between areas inside and outside of Steller sea lion conservation areas complicated monitoring since daily monitoring of harvests was needed in two different areas. Tracking harvests was also complicated by fishers moving in and out of the conservation areas. Failure to monitor harvests of each vessel on a daily basis could possibly result in the TAC being exceeded. Under the AFA, harvest shares are allocated to the cooperatives prior to the season. Each cooperative is provided with a specific harvest share so timing of the closure is not critical to attaining the desired TAC. While harvest activity must still be monitored to ensure compliance, daily monitoring is not necessary to ensure that the TAC is not exceeded by legal harvests. By allocating shares in the fishery, the AFA simplified monitoring harvests in the fishery.

The cooperative nature of the AFA fishery has also reduced the risk of overharvests. The AFA provides flexibility in the fishery, as fishers can transfer harvest shares within their cooperatives. Tracing these transfers could complicate enforcement in the fishery. To avoid these complications, the cooperatives are required to monitor the trading of fishing shares. Although NMFS positions observers on all vessels over 125 feet in length at all times, cooperatives are required to self monitor their activity in the fishery. The cooperatives monitor the distribution and trade of harvest rights to ensure that directed harvest and bycatch limits are not exceeded. To accomplish this monitoring task, the cooperatives use a common monitoring agent and have established a penalty schedule for overharvests. The self monitoring among cooperatives has helped ensure that harvest limitations (including those intended to protect Steller sea lions such as limits on harvests in Steller sea lion conservation areas) are adhered to. In the first two years of the AFA, no penalties have been assessed for cooperatives exceeding harvest allocations of any species.

The AFA is intended to rationalize only the BSAI pollock fishery. Since several of the vessels and processors participating in the BSAI pollock fishery also participate in other fisheries, sideboard regulations were adopted that provide AFA participants with a fixed shares of these other fisheries. Without the sideboards, AFA participants were thought to have an unfair advantage in other fisheries since participating in those other fisheries would not affect their fixed harvest shares in the BSAI pollock fishery. These sideboard limitations also have removed AFA participants from races for fish in these other fisheries reducing the benefits of temporally concentrating harvests.

While the AFA decreased the incentive to concentrate harvest activity, some of the benefits of temporal and spatial concentration of harvests continue to be present under AFA. For example, a fisher's production costs might be reduced by harvesting fish in a single location for a short time period. By concentrating efforts in a single time period and in a small area may minimize some variable costs, such as fuel. Concentration of effort spatially and temporally may also free up the vessel to participate in other fisheries (to the extent permitted under the AFA sideboard restrictions). Similarly, the supply of harvests to processors must be maintained above some minimum level to avoid costly production slow downs. In addition, processors might benefit from the delivery of all pollock in a single more concentrated period to free up their processing lines allowing the processing of other species or simply close the plant to reduce variable costs.

Lucrative production of roe also contributes to the preference for spatial and temporal concentration of harvests. Roe production in the pollock fishery is concentrated in a few areas (including some areas in Steller sea lion critical habitat) during the A season. Since roe production substantially increases revenues from the pollock fishery, A season roe bearing harvests are heavily sought by fishers. So, even though the AFA has removed some of the incentives for concentrating harvests temporally and spatially, some benefits to concentrating harvests can be expected to persist.³

³ The AFA only removed the incentives to concentrate harvests temporally and spatially that were artifacts of the season length management regime, maintaining those that arise out of production technologies and natural SSL Protection Measures SEIS

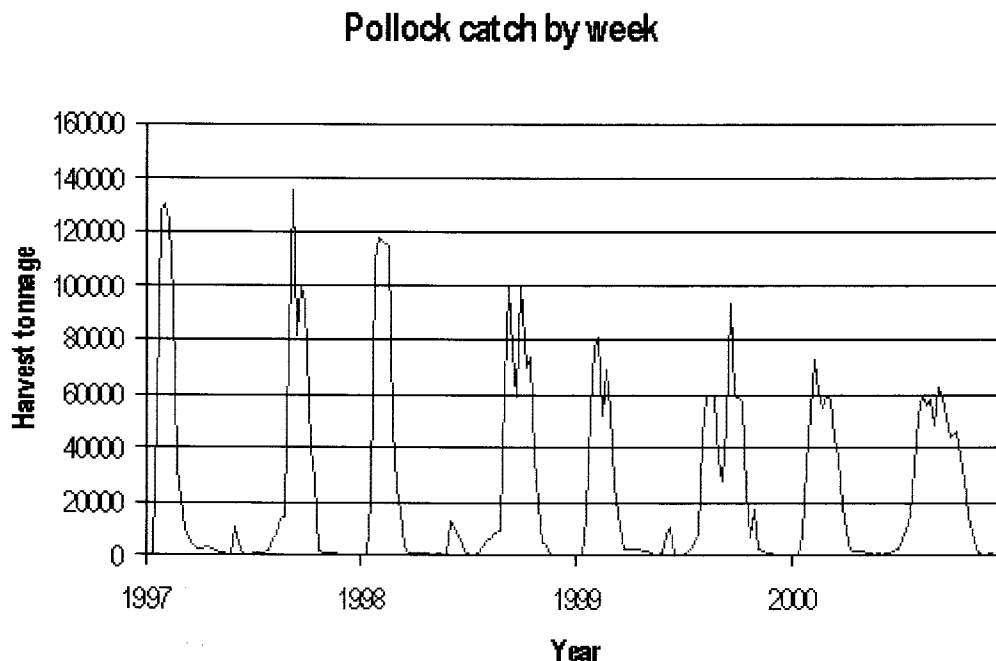
The AFA also has not eliminated the motivation for fishing in Steller sea lion critical habitat. Some of the most productive fishing grounds are located in Steller sea lion critical habitat. The regulation of harvests in critical habitat clearly affected the behavior of fishers who were forced to fish in other areas. Since critical habitat contains some of the best fishing grounds, fishers had an incentive to complete the harvests in critical habitat before moving to other fishing areas. Under the AFA, the division of harvests inside and outside critical habitat existed, but fishers do not risk sacrificing harvests in critical habitat if they elected to fish areas outside of critical habitat first. The result is that fishers have less incentive to concentrate harvests in critical habitat early in the season, decreasing the incentive for local depletion of stocks that are thought to threaten Steller sea lions. To further reduce potential interactions of Bering Sea pollock fisheries and sea lions within critical habitat, the preferred alternative prohibits trawling for pollock within the Southern Bering Sea Restriction Area.

The AFA was implemented over two years. In the 1999 season, the AFA cooperative provisions were applied to the catcher processor fleet in the BSAI pollock fishery. In the 2000 season, the AFA was implemented for both inshore processors and motherships. The change in the temporal distribution of harvests is evident in these two. Figure 4.11-1 shows weekly pollock harvests from the BSAI pollock fishery from 1997 to 2000, inclusive. Although all four show significant variability in harvests and periods of concentrated harvests, the 1999 and 2000 have substantially greater dispersion of harvests than the 1997 and 1998. Although all of the years represented show peaks in harvests in the first and third quarters, the 1999 and 2000 both have significantly lower peaks that are spread over greater periods of time. This trend is partially the result of the Steller sea lion measures that require the temporal dispersion of harvests but AFA implementation contributed to this dispersion of harvests. Comparing the 1999 and 2000 with the two previous shows the increasing dispersion of harvests. In the first and third quarters of both 1997 and 1998, harvests from a single week exceeded 100,000 metric tons. In 1999 and 2000 harvests did not exceed 100,000 metric tons in any week. The increase in dispersion of harvests is also evident in the gradual increase in the number of weeks in each year that harvests exceeded 20,000 tons. In 1997, harvests exceeded 20,000 tons in 14 weeks. In 2000, harvests exceeded 20,000 tons in 22 weeks.

In summary, the "rights-based" nature of the AFA pollock fisheries eliminated the race to fish, thereby allowing self-monitoring, helping to ensure compliance with the various Steller sea lion regulations, and ensuring that individual spatial and temporal harvest limits (including limits on harvests in Steller sea lion conservation areas) are not exceeded. Without the AFA, compliance with and monitoring and enforcement of Steller sea lion protection measures would be greatly complicated, and possibly inadequate.

conditions in the fishery. The restriction on deliveries of harvests to a single processor might create some bias in favor of concentrating deliveries temporally.

Figure 4.11-1 Weekly pollock harvests from the BSAI pollock fishery, 1997 to 2000



Source: NMFS Blend Data

4.11.5 Significance Rating of the Alternatives' Impact on Management and Enforcement

Rating the significance of the alternatives with respect to their impact on management and enforcement is based on assessing two primary issues described in Section 3.11. These two issues are (1) monitoring and enforcing compliance with areas closed to protect Steller sea lions, and (2) managing the commercial harvest of pollock, Pacific cod, and Atka mackerel within specified catch limits. Table 4.11-6 summarizes the basis of significance ratings for these two issues. Two categories of significance were identified for each issue - "significant - adverse" or "insignificant." "Significant - adverse" means that the alternative significantly increased the complexity of monitoring, enforcing, and managing the commercial fisheries under the Steller sea lion protection measures. The significance levels of "conditionally significant" and "unknown" were determined to be inapplicable to these issues because NMFS does have the information necessary to rate the level of significance of the alternatives on management and enforcement.

All of the alternatives would significantly increase the complexity of monitoring and enforcing compliance with areas closed to protect Steller sea lions because each alternative involve closing areas with complex boundaries and closures to directed fishing. As discussed above in Section 4.11.3, Alternative 1 is the least complex and Alternative 4 is the most complex. Alternatives 2 through 5 significantly increase the complexity of managing the commercial harvest of pollock, Pacific cod, and Atka mackerel within specified catch limits. Alternatives 2 and 3 create the most new quota categories and small quotas. Alternative 4 creates new quota

categories and includes a new management system for the BSAI Atka mackerel fisheries. Overall, with respect to the issue of fisheries management complexity, Alternative 2, with its many new quota categories, daily catch limits, and seasonal exclusive area registration is the most complex among the five alternatives.

Table 4.11-6 Explanation of criteria for rating significance of management and enforcement impacts

Issue	Significant	Conditionally Significant (beneficial)	Conditionally Significant (adverse)	Insignificant	Unknown
Monitoring and Enforcing Compliance with Area Closures	Creates complex Area boundaries and increases the number of directed fishing closures	Not Applicable	Not Applicable	Does not create complex area boundaries or increase the number of directed fishing closures	Not Applicable
Managing Harvest Within Specified Catch Limits	Increases the number of quota categories and decreases the amount of catch available in the quota categories	Not Applicable	Not Applicable	Does not change the number of quota categories or the size of quotas	Not Applicable

Table 4.11-7 Summary of effects of Alternatives 1 through 5 on management complexity and enforcement.

Management Complexity and Enforcement Issue	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Monitoring and Enforcing Compliance with Area Closures	S-	S-	S-	S-	S-
Managing Harvest Within Specified Catch Limits	I	S-	S-	S-	S-

S = Significant, I = Insignificant, - = adverse

4.12 Economic Consequences

4.12.1 Economic Impacts and Values

This section provides a summary of the estimated economic consequences of the proposed alternatives being analyzed to address the decline in the population of western Steller sea lions. The five alternatives as presented and discussed in Chapter 2 (Alternatives Including the Proposed Action), as well as Chapter 1 of the Regulatory Impact Review (RIR) (Appendix C of this SEIS). The RIR contains an analysis of the economic impacts of the respective alternatives, as well as their distribution across affected "user groups." The results of the RIR are summarized in this section.

The RIR describes and analyzes a broad set of economic "cost and benefit" elements to illustrate the respective economic impacts of the several competing alternatives, including the status quo (or "no action") alternative. The "cost and benefit" factors treated in the analysis include:

1. Existence Values
2. Non-Market Use Value (e.g., subsistence)
3. Non-Consumptive Use Value (e.g., eco-tourism)
4. Harvest Levels and Fish Prices
5. Operating Cost Impacts
6. Groundfish Market Values
7. Safety Impacts
8. Impacts on Related Fisheries
9. Consumer Effects
10. Management and Enforcement Costs
11. Excess Capacity
12. Bycatch and Discard Considerations

Identification and inclusion of these factors are a result of commonly used measures of economic and socioeconomic effects of commercial fisheries, or were identified in the scoping process. Significance determinations for economic and social impacts of the factors listed above follow the same as defined in section 4.0.

4.12.1.1 Existence Values

Existence value refer to the economic value that society places upon "knowing" that Steller sea lion populations are stable and flourishing in their natural environments. This is a non-market value, because no actual market exchange takes place. As noted in the RIR, empirical research on existence value has indicated that, in general, these values may be substantial for recovery of wildlife populations.

Each of the alternatives to the status quo would yield an outcome under which the existence values associated with the western Steller sea lion stocks will provide an incremental benefit over the no-action alternative (Alternative 1). The 2000 Biological Opinion states that continuation of the no action alternative results in jeopardy for the Steller sea lion. Each of the alternatives was designed to provide sufficient protection to change the no action jeopardy finding to a "no jeopardy" situation. Section 1.3.2.1 of the RIR did not find sufficient information to rank order the level of protection provided by Alternatives 2 through 5, relative to

one another. Nevertheless, each of the alternatives (Alternatives 2 through 5) are expected to meet the minimum jeopardy threshold and, thus, yield a net gain in existence value, over the no action alternative.

Conditionally significant positive impacts are shown for each alternative, with the exception of Alternative 1, which is a conditionally significant negative impact (Table 4.12-A). The magnitude of gains in existence value are uncertain from available data and research, but from research on other wildlife populations it can be assumed such values exist and are substantial in magnitude.

4.12.1.2 Non-Market Use Values (Subsistence)

Section 1.3.2.2 of the RIR reviews known patterns of subsistence use of Steller sea lions. Two specific impacts to subsistence harvests are identified. First, declining numbers of Steller sea lions can reasonably be assumed to increase the costs of subsistence harvests. The second effect is that fewer sea lions are likely to be harvested in total. While this may result in subsistence hunters "substituting" other subsistence species or replacing lost sea lion meat with purchased food, the loss of their preferred species (Steller sea lion) will impose real economic and cultural costs on these individuals, their families, and villages.

The RIR analyses of subsistence use of Steller sea lions concludes that each of the proposed alternatives would be expected to yield a positive benefit to subsistence users. While not readily quantifiable, it can be expected that welfare improvements (i.e., positive economic, cultural, and social benefits) will be directly associated with improvements in abundance of Steller sea lions. Based on this assumption, the ordinal ranking of attributable benefits to non-market (i.e., subsistence) users associated with each alternative, is as follows: [with 1st being the alternative with the "highest potential benefit" to non-market users, as compared with the "no-action" alternative, and 4th being the alternative with the least potential for positive benefits for this use category, compared with Alternative 1.]

Alternative 2	ranked 1 st in comparison with no-action baseline
Alternative 3	ranked 3 rd in comparison with no-action baseline
Alternative 4	ranked 2 nd in comparison with no-action baseline
Alternative 5	ranked 4 th in comparison with no-action baseline

Although the western stock of Steller sea lions has been determined to be an endangered species, under the Endangered Species Act (ESA), the ability of subsistence hunters to harvest Steller Sea lions has not yet been restricted by regulation. Under the status quo, subsistence users are not restricted from harvesting Steller sea lions, and the impacts of reduced Steller populations are principally reflected in increased costs (due to reduced cost per unit of effort) and decreased total harvests, as noted above. There are additional impacts, however, stemming from traditional patterns of sharing both within families and communities, and across community lines.

At present, subsistence harvests are sufficiently small that the potential biological removals are not a threat to recovery of the species. However, if the population continues to decline, at some point the situation would likely trigger a formal hearing under Section 103 of the Marine Mammal Protection Act (MMPA). At that point, restrictions to subsistence harvests would be considered and could be implemented. This would impose further adverse economic, social, and cultural costs on these users, and increase the welfare loss they and their communities already have incurred.

A conditionally significant positive impact of each alternative to the "no action" Alternative 1, is shown in Table 4.12-A. The magnitude of gains in subsistence values are uncertain from available data and research.

Alternative 1 would be assumed to yield a conditionally significant negative impact, on this criterion.

4.12.1.3 Non-Consumptive Use Values (Eco-tourism)

Eco-tourism clients, and those involved in providing services to those persons, may place an economic value on use of the Steller sea lion resource for viewing, photography, and other non-consumptive use. Section 1.3.2.2 of the RIR indicates that it is "virtually certain that such values do exist and that they are positive." However, no research is currently available to ascribe estimates of non-consumptive use values to the Steller sea lion resource.

Utilizing the same logical assumptions as for subsistence uses, one can reasonably assume that benefits are likely to be highly correlated with improvements in abundance of Steller sea lions. Therefore, the respective ordinal ranking of the different alternatives in providing benefits to non-consumptive users is presumed to be identical to those shown above for subsistence users:

Alternative 2	ranked 1 st in comparison with no-action baseline
Alternative 3	ranked 3 rd in comparison with no-action baseline
Alternative 4	ranked 2 nd in comparison with no-action baseline
Alternative 5	ranked 4 th in comparison with no-action baseline

A conditionally significant positive impact of each alternative to the "no action" Alternative 1, relating to non-consumptive users is shown in Table 4.12-A. Alternative 1 would be assumed to yield a conditionally significant negative impact, on this criterion.

4.12.1.4 Harvest Levels, Price Effects, and Gross Revenues

This section summarizes the catch levels and associated price effects, attributable to each of the alternatives. Section 1.3.3.1 of the RIR reviews the positive and negative changes that could be anticipated from changes in aggregate catch levels and market parameters. One of the most important potential changes is likely to come from revenue changes due solely to the volume of fish landed and processed. An economic model was developed to address the "first wholesale" gross revenue changes to the several affected fishing sectors. Table C-18 of the RIR provides a summary of the first wholesale gross revenue impacts for each alternative. Table C-18 shows the total gross revenues (at the first wholesale level) for each of the alternatives, including the "no action" alternative. Estimates are provided for first wholesale gross revenue changes: (1) solely attributed to TAC reductions, (2) placed "at risk" due to closed critical habitat, (3) from open, but otherwise "restricted" critical habitat. In order to crudely "bound" the potential total impact, under a worst-case scenario, the loss attributed to TAC changes (from the first row of Table C-18) can be added to the estimated total revenues "at risk" (identified on row 5 of the table). This summation implicitly assumes that all the catch placed "at risk" will be foregone. It is, however, possible that some of the fish "at risk" may be harvested by fishermen, in other areas or during alternative times of the year, but there is a great deal of uncertainty as to how much might be captured and by whom.

An example may help to demonstrate this derivation. Based on impacts from changes "only" to the TAC, Alternative 2 (which is the only alternative that results in impacts which are significantly different from the "no action" Alternative 1 on this criterion) results in total potential first wholesale gross revenues on the order of \$973 million. The estimated first wholesale gross revenue under Alternative 1 is \$1.358 billion,

thus the specified change in TAC alone, contained in Alternative 2, represents a reduction of 28 percent in first wholesale gross revenues.

If one adds harvest amounts that are potentially placed "at risk" as a result of provisions of Alternative 2, assuming the industry is not able to make up the loss from critical habitat areas, with harvests in other areas, the total first wholesale gross revenue associated with adoption of Alternative 2, declines to approximately \$645 million. This represents a reduction of 52.5 percent from the Alternative 1 baseline. This would be interpreted as the worst-case situation for Alternative 2, as measured against the "no action" baseline case.

Table 4.12-A shows a significant negative impact for Alternative 2 and Alternative 3. Alternative 4 has an insignificant impact, while Alternative 5 has a conditionally significant negative impact. Alternative 4, Alternative 4 with option C, and Alternative 5, all show first wholesale gross revenues very nearly the same as the Alternative 1 baseline. Alternative 4 and Alternative 4 with option C, show a relatively small negative "at risk" impact on the order of \$75-\$80 million, and Alternative 5 has an impact estimated to be on the order of \$133 million overall.

The ranking within alternatives is as follows:

Alternative 2	ranked 4 th in comparison with no-action baseline
Alternative 3	ranked 3 rd in comparison with no-action baseline
Alternative 4	ranked 1 st in comparison with no-action baseline
Alternative 5	ranked 2 nd in comparison with no-action baseline

An analysis of ex-vessel gross revenue impacts, by various catcher vessel sub-fleets, categorized by gear and vessel length, is addressed in the RIR (Appendix C). Tables C-2 through C-13 of the RIR show the relative dependency of each sub-fleet and gear type on gross revenues from pollock, Pacific cod and Atka mackerel. Those categories showing dependence levels on the respective species are at or greater than the 10 percent to 20 percent range and are at greatest risk for diminished ex-vessel gross revenues as harvests decline.

4.12.1.5 Operating Cost Impacts

Section 1.3.3.3 of the RIR addresses potential changes to the operating costs associated with changes in harvest levels under the different alternatives. The main categories of direct costs include:

- increased travel time to and from more distant fishing grounds
- costs of learning new fishing grounds
- costs of undertaking bycatch avoidance measures, or premature closure due to excessive bycatch if these efforts are unsuccessful
- reduced catch per unit of fishing effort due to less concentrated stocks – including "platooning" as a possible partially mitigating response
- costs of stand downs and lay-ups
- maximum daily catch limits
- potential gear conflicts
- costs of fishing pollock, Pacific cod, or Atka mackerel when other economically important fisheries are open
- costs to processing facilities built for higher rates of throughput
- reduced safety of fishing operations

The RIR provides a substantial record and supporting discussion of qualitative impacts associated with increased operating costs, attributable to each of the alternatives. There are numerous examples of specific adverse impacts to sub-fleets, areas, or fisheries presented. As a generalization, one may expect that each of the alternatives will impose operational changes that will increase costs to fishing vessel operators.

Table 4.12-A shows a conditionally significant negative impact for Alternatives 2, 3, 4, and 5. Some of the types of operational cost increases are addressed sufficiently and thoroughly in a quantitative manner to determine that these negative impacts will be as anticipated. However, direct estimates for the magnitude of the cost, by alternative, cannot be determined from the available information.

Table C-22 of the RIR provides a summary of the overall direction and ordinal ranking of the alternatives, based upon expected impacts on the operating cost factors listed above.

Alternative 2	ranked 4 th in comparison with no-action baseline
Alternative 3	ranked 3 rd in comparison with no-action baseline
Alternative 4	ranked 1 st in comparison with no-action baseline
Alternative 5	ranked 2 nd in comparison with no-action baseline

4.12.1.6 Groundfish Market Values

Impacts on markets for pollock, Pacific cod, and Atka mackerel are analyzed in Appendix D of this SEIS (Market Analysis of Alaska Groundfish Fisheries: Alaska Pollock, Pacific Cod, and Atka Mackerel). Utilizing the estimated changes in harvested volumes for each of the above species, the authors of this report analyzed the changes in prices and product revenues associated with Alternatives 2 and 4. The report addresses product prices, quantities, volumes, product forms, market share, and balance of trade considerations. The analysts utilized the total metric tons of catch "not at risk" as the determinate of harvest quantity as they examined each alternative. The authors conclude that while it could be argued that some of the tons "at risk" could, in fact, be harvested in alternative areas or during subsequent periods, these minimum harvest levels could be interpreted as providing the worst-case scenario impact.

Under Alternative 2, retained harvests are reduced by 43%, which will severely affect production of all Alaska pollock products. Fillet production is expected to be affected at a greater extent than surimi, due in part to supply contracts and vertical integration among surimi processors with wholesalers and retailers in Japan. Surimi production would be reduced by a substantial amount — perhaps 25% or more — but is not likely to decline in as high a proportion as landings, all else remaining equal. The impact on roe supply would be substantial under Alternative 2, as the potential roe harvest could be as little as half that of the "no action" alternative. A large, permanent reduction of total revenues from roe sales could cause dramatic changes in the structure and form of the fishery, with repercussions to other product forms, pollock markets, and consumers.

The Pacific cod TAC under Alternative 2 would decline to just over half of the baseline, resulting in nearly a 10% drop in world cod landings and likely a weakened supply of domestic cod fillets. Producers could be somewhat compensated for losses in quantities produced by increased domestic prices, but it is also likely that consumers would switch to other, cheaper products. Under Alternative 2, Atka mackerel landings would decrease to just 25% of current landings, very likely resulting in a significant adverse impact on the fishery.

Under Alternative 4, the retained harvests are reduced by a very small amount, resulting in only small impacts to the supply of pollock surimi, fillets, and roe. Alternative 4 is likely to have a similarly negligible effect on domestic and international markets for Pacific cod, as impacts on processors, distributors, and brokers would be greater individually than in the aggregate, with little effect in the general economy.

The groundfish product values are significantly negatively impacted for Alternative 2, and much less severe, or insignificant, under Alternative 4. By interpolation, we can extend these results to Alternatives 3 and 5. Both are evaluated to have conditionally significant negative impacts. These significance ratings are shown in Table 4.12-A. Alternative 2 is assigned a significant adverse impact ranking and Alternative 3 is assigned a conditionally significant adverse ranking, because the quantification of the level of negative impact is by interpolation rather than by direct estimation. Similarly, Alternative 4 is ranked as having an insignificant impact, and Alternative 5 is ranked as having a conditionally significant negative impact.

The ordinal ranking of impacts to the product values from the different alternatives can reasonably be extracted from the information in Appendix D to be:

Alternative 2	ranked 4 th in comparison with no-action baseline
Alternative 3	ranked 3 rd in comparison with no-action baseline
Alternative 4	ranked 1 st in comparison with no-action baseline
Alternative 5	ranked 2 nd in comparison with no-action baseline

4.12.1 Safety Impacts

Section 1.3.3.4 of the RIR addresses safety issues relating to each of the alternatives. The safety factors discussed include: fishing further offshore, during periods of extreme weather, and on more exposed or remote grounds. The section also addresses the relationship between safety and reduced profitability. Several of the alternatives contain provisions which seek, either directly or indirectly, to accommodate the differential capacities and characteristics of the fleets operating in the regulated fisheries. For example, provisions explicitly exempt some of the smaller vessel classes from some area restriction (e.g., Pacific cod jig boats). But such provisions are not limited to the very smallest boats in the fleet. Indeed, Alternative 4 (for example) adopts existing language from the AFA, to provide vessels in the EBS pollock fishery, 99 feet and under, a "safety" motivated exemption from closures of the SCA area (for details, see Section 1.3.3.4 of the RIR).

The analysis of safety impacts in the RIR concludes that, given available data, it is not realistic to make numerical estimates of the changes in the occupational fatality rates that would be caused by provisions of the different alternatives. A qualitative assessment yields some information to compare the impacts. Provisions governing the timing and fishing area restrictions, contained in Alternatives 2, 3, and 5, would force vessels to fish further offshore and/or during periods when operating conditions are potentially more extreme. Alternative 4 would, by comparison, reduce these likely effects. Alternatives 3 and 5 are similar in their structure, and have similar characteristics in terms of their rankings on the safety criterion. Alternative 2 clearly results in the largest structural change to the baseline patterns of fishing, and would impose a very high risk of additional accidents, injuries, and possible fatalities. However, the substantially reduced fishing time that likely would accompany the extremely large reduction in TAC prescribed under this alternative probably reduces the aggregate risk factors, attributable to Alternative 2, to be slightly lower than those for Alternatives 3 and 5.

The ordinal rankings for the respective impact on safety, for the different alternatives, are shown in Table 4.12-A. While one cannot estimate a numerical measure of the safety impacts which may accompany adoption of one or another of the competing alternatives, one may conclude that these impacts do exist, based on alterations to fishing patterns and distances. Until additional data are available, the safety impacts are rated as having conditionally significant adverse impacts, for each of the alternatives to the status quo alternative.

Based on the analyses in the RIR, the ordinal ranking of the alternatives on the safety criterion, relative to the "no action," Alternative 1, is as follows:

Alternative 2	ranked 2 nd in comparison with no-action baseline
Alternative 3	ranked 4 th comparison with no-action baseline
Alternative 4	ranked 1 st in comparison with no-action baseline
Alternative 5	ranked 3 rd in comparison with no-action baseline

4.12.1.8 Impacts to Related Fisheries

The category of Impacts to Related Fisheries includes changes induced by the Steller sea lion measures within the pollock, Pacific cod, and Atka mackerel fisheries that may have "spill-over" effects on other fisheries. The potential impacts, discussed in Section 1.3.3.5 of the RIR, include: increases in non-target catches of Pacific cod and pollock, as related to IR/IU requirements; effects of displacing capacity from SSL regulated fisheries into other non-regulated target fisheries; increased costs of gearing up, associated with pre-season planning uncertainty; implications and opportunities for topping off behavior; and increased bait costs in crab fisheries. The impacts of each of these factors are discussed in principally qualitative terms in the RIR.

The RIR analyses include an assessment of direct and indirect impacts to related fisheries (e.g., salmon, halibut, crab), as part of operating cost impacts. No data are available to determine the net result of these complex, interrelated effects which may accompany adoption of any one of the competing alternatives. For this reason, each of the alternatives has been determined to have an unknown impact ranking, for impacts to related fisheries. Implementing any of the alternatives, other than Alternative 1, will trigger a number of complex interactions in all of Alaska's commercial fisheries. Fishermen probably are uncertain themselves how they will deal with the changes that are likely to occur under each of the different alternatives.

4.12.1.9 Costs to Consumers

Section 1.3.3.1 of the RIR includes a brief discussion of some potential market impacts resulting from reductions in harvests of pollock, Pacific cod, and Atka mackerel under each of the respective alternatives. A more detailed and focused analysis of markets and market effects is provided in Appendix D of this SEIS.

As reported in Appendix D, surimi from Alaskan pollock is primarily sold to Japan. Surimi prices are likely to increase in Japan, if the supply of pollock is reduced. The Alaska pollock fillet market is mostly a domestic market, and the demand within the United States far exceeds the available supply. The price to consumers for pollock fillets will rise only if there is a very large change in the amount of pollock fillets supplied. The discussion of the market analysis suggest an interpretation of a price increase to domestic pollock fillet consumers under Alternative 2, and no change in price attributable to Alternative 4.

A large share of Alaska's Pacific cod harvests is consumed within the United States. Appendix D concludes that if the quantity of Pacific cod is reduced by a small amount, the per unit price may hold steady or rise slightly. Atka mackerel is almost all exported from the United States, primarily to Korea or Japan. If the supply is reduced, the unit price will likely rise.

In summing the potential combined market impacts of the different alternatives, Appendix D suggests that the prices to consumers in the U.S. will rise slightly if the quantity of pollock and Pacific cod is reduced by the respective alternatives. Using the analyses in Appendix D, the impact of Alternative 2 can be ranked as having a conditionally significant adverse impact. Alternative 4 can be ranked as having an insignificant impact. Because the analyses in Appendix D did not specifically address Alternatives 3 and 5, it is necessary to interpolate rankings between these two results. Using the data from Table C-18 of the RIR, it can be suggested that Alternative 3 should be ranked as having a conditionally significant negative impact (similar to Alternative 2) and that Alternative 5 should be ranked as having an insignificant impact (similar to Alternative 4).

4.12.1.10 Management and Enforcement

Alternatives 2 through 5 will require increases in staff and budget for NMFS enforcement and management. Section 1.3.5 of the RIR (Appendix C) provides annual cost increase estimates of \$852,000 per year for Alternatives 2, 3, and 5, and \$952,000 for Alternative 4 (owing to the latter alternatives additional in-season management complexity).

Table 4.12-A shows a significant adverse rating for each alternative, on this criterion. Actual costs are likely to vary somewhat from this initial estimate, but the RIR clearly demonstrates the type and magnitude of impact which will likely accompany adoption of any of these SSL Protection Measures.

4.12.1.11 Excess Capacity

The issue of excess capacity is addressed briefly in Section 1.3.3.5 of the RIR. At present, there is no available quantification of the net result of the interactions likely to occur within both the fishing and processing sectors on excess capacity. We know that the projected harvests under Alternatives 2, 3, and 5 are likely to be less than the Alternative 1 baseline (Table C-18 of the RIR; Tables 6.1 through 6.3 of Appendix D).

It is likely that the effects of the changes imposed under at least Alternatives 2, 3 and 5 will result in excess capacity in the harvesting sector. Similarly, the change in volume of fish landed under the alternatives will likely result in some level of reduced capacity utilization within the processing sector. However, there are no data or quantified estimates available to more fully understand these impacts. Accordingly, Table 4.12-A ranks each of the alternatives as having an unknown impact with respect to excess capacity.

4.12.1.12 Bycatch and Discards

The cost of bycatch, and associated avoidance measures, is briefly discussed in Section 1.3.3.3 of the RIR. This discussion includes several qualitative examples of how bycatch avoidance will likely impose increases in operating costs on some commercial operators. This section of the RIR does not include quantified estimates of operating cost increases that may be attributable to prohibited species concerns under the different alternatives.

Prohibited species bycatch from a biological perspective is addressed in Section 4.5 of this SEIS. In general, this section finds that there are relatively minor changes to prohibited species catches for each of the alternatives. The few exceptions are noted below.

The impacts by alternative are rated as having insignificant impact in the Bering Sea and Aleutian Islands, except for showing a conditionally significant positive impact for salmon in the Bering Sea under Alternative 2 (Tables 4.5-3 and 4.5-4); a conditionally significant negative impact for other king crab in the Bering Sea under Alternative 2; a conditionally significant positive impact for Aleutian Islands chinook salmon; and a conditionally significant positive impact for 'other Tanner crab' under Alternatives 2, 3, and 4. The impacts by alternative are all ranked as having an insignificant impact in the Gulf of Alaska.

There is no quantitative method to "link" the biological findings of prohibited species catch impacts, by alternative, to economic costs to fishing operations, nor is there a quantitative evaluation of the impacts that the different alternatives will have upon fish discards. The fishing restrictions imposed under each of the alternatives may result in fishermen having to fish in waters that have previously not been fished. The results of this change are not known, but it is reasonable to assume that at least some of the fishing activity in new areas will result in greater discards of non-target species.

Due to the reasons cited above, the impacts of the different alternatives on prohibited species catches and on discards are ranked as having an unknown impact.

Table 4.12-A Summary of effects of Alternatives 1 through 5 on Economic Impacts

Economic Indicators	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
1. Existence Values	CS-	CS+	CS+	CS+	CS+
2. Non-market Subsistence	CS-	CS+	CS+	CS+	CS+
3. Non-consumptive Eco-tourism Use	CS-	CS+	CS+	CS+	CS+
4. Harvests & Fish Prices	CS+	S-	S-	I	CS-
5. Operating Cost Impacts	CS+	CS-	CS-	CS-	CS-
6. Groundfish Market Values	CS+	S-	CS-	I	CS-
7. Safety Impacts	CS-	CS-	CS-	CS-	CS-
8. Impacts on Related Fisheries	U	U	U	U	U
9. Costs to Consumers	CS+	CS-	CS-	I	I
10. Management and Enforcement	I	S-	S-	S-	S-
11. Excess Capacity	CS-	U	U	U	U
12. Prohibited Species Catch	I	U	U	U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.12.2 Social Impact Assessment

This section contains an overview of the social impact assessment process (Section 4.12.2.1), an effects analysis by region and alternative (Section 4.12.2.2), and an environmental justice effects analysis (Section 4.12.2.3). In general the analysis of socioeconomic impacts is presented on a regional basis and by alternative, and by fishery within each alternative. This analysis is predicated on modeling outputs as seen in Tables 4.12-1 through 4.12-49 that appear at the end of this section. Analysis in this section includes Alternatives 1, 2, and 4. Alternative 1 represents the baseline against which impacts of other alternatives are measured, as discussed elsewhere. Alternatives 2 and 4 were chosen for this social impact assessment to represent the high (Alternative 2) and low (Alternative 4) end of the range of impacts that could result from the full suite of alternatives considered. Analysis of impacts to the CDQ region involves slightly different assumptions, as detailed in Section 4.12.2.2.7, and the modeling outputs for the CDQ region are provided in Tables 4.12-50 through 4.12-56. Additional tables (Tables 4.12-57 through 4.12-63) containing impact variables relevant only to the CDQ region are also presented and discussed in that same section. Potential impacts to subsistence are noted in the overview section below, but are analyzed in detail in Appendix F(3).

4.12.2.1 Overview

Tables 4.12-1 through 4.12-49 each provide information on 21 socioeconomic indicators considered relevant for understanding the changes in the fishery and regions/communities that could result from the alternatives, and these are each broken into constituent parts proportionally assigned to pollock, Pacific cod, and Atka mackerel related activity. Although each of these 21 variables is important as they provide insight into different industry and regional/community links, for the sake of brevity the discussion in this section focuses on a subset of five key indicators. These are:

- **Total regionally owned catcher vessel harvest volume.** This provides a gross indication of direct participation by regional residents in the harvest sector.
- **Total ex-vessel value paid by shorebased processors in the region.** This figure provides a good indication of the relative value of the relevant groundfish species coming ashore in the region, and provides a good indicator of the level and changes in level of the local fisheries related tax base.
- **Total shorebased processing volume in the region.** This provides an indication of the level of activity taking place on shore in the region.
- **Total harvesting and processing payments to labor accruing to the region.** This indicator illustrates the value of the fishery employment to the residents of the region.
- **Total harvesting and processing employment accruing to the region.** This indicator provides a means to track changes in the total groundfish fisheries employment in the region.

Each of these indicators is tied to a number of other indicators that are meaningful for the regions involved. For example, total regionally owned catcher vessel harvest data corresponds in a direct fashion with total ex-vessel value. However, since the two track directly, the discussion that follows only covers one of these variables.

Subsistence use of groundfish resources will not be changed by any of the alternatives, and total groundfish availability for subsistence use will not be negatively impacted by any of the alternatives. Similarly, for Steller sea lion subsistence use, none of the alternatives change subsistence pursuits of Steller lions, and none of the alternatives are expected to reduce Steller sea lion populations available to subsistence users. To the extent that the alternatives have a direct or indirect beneficial impact on Steller sea lion populations, impacts to subsistence use of Steller sea lions could be positive. The alternatives could result in indirect impacts to subsistence activities directed toward a wide range of resources through the a loss of income that would otherwise be directed toward funding subsistence pursuits, or through the loss of access to subsistence opportunities that would otherwise occur during the commercial fishery or by utilizing commercial fishery gear that would otherwise be available were it not for changes brought about by the alternatives. In general, however, while some alteration of subsistence activities of particular individuals may take place, subsistence impacts to the communities are considered to be negligible under each of the alternatives. King Cove and Sand Point may be communities where loss of joint commercial and subsistence production impacts may be felt more strongly than in other communities. An extended discussion of each of these subsistence topics is provided in Appendix F(3).

4.12.2.1.1 High and Low Estimates

As shown in Tables 4.12-1 through 4.12-49, a high estimate and a low estimate are provided for each alternative. The high estimate is based on the assumption that all of the available TACs of pollock, Pacific cod and Atka mackerel are harvested, including portions of the TACs that are directly affected by the Alternative. The high estimate in this sense represents a "best-case" scenario for the alternative. It should be reiterated that the alternatives will have a direct impact on TACs and that the high estimates incorporate these TAC changes. It should also be noted that even if all of the portions of the available TACs directly affected by the Alternative are harvested, other "normal" factors could affect the outcome including market conditions, unanticipated bycatch closures or lower than anticipated catch rates. Thus it is unlikely that even under the best conditions the high estimate will actually be attained.

The low estimate is based on the assumption that none of the portions of the available TACs that are directly affected by the Alternative are harvested—the low estimate eliminates all "at-risk" harvests. In other words, the low estimate assumes that fishers make no attempt to adapt their fishing patterns, and simply forego harvests of all portions of the TACs that are directly affected by the Alternative. Because fishers have shown a great deal of adaptability in the past, it is unlikely that the harvest and processing levels associated with the low estimate will occur. It is more likely that the actual outcome will fall somewhere between the high estimate and the low estimate. However, the low estimate may not necessarily represent a "worst case" scenario, because other outside factors could influence the outcome. These outside factors include market conditions and catch rates in traditional fishing areas, among others, and could conceivably combine to result in outcomes that are worse than the low estimate. (In each of the regional discussions below, the difference between the high and the low estimate are discussed for each alternative, as this represents the degree of uncertainty fishery participants will face when trying to adapt their strategies to changing conditions.)

For each of the regions, the following analysis compares the high estimates of Alternatives 2 and 4 to the high estimate under the baseline as depicted by Alternative 1. Comparisons show the difference in the alternative calculated by subtracting the results of Alternative 1 from the results of the alternative being analyzed – in mathematical terms (using Alternative 2 as an example) it would read **Difference = Alt. 2 – Alt. 1**. Percentage differences are estimated by dividing the difference by the outcome under the alternative – in mathematical terms the percentage is calculated as **Percentage Difference = Difference ÷ Alt. 1**. Similar comparisons are made between the low estimates of the baseline (Alternative 1) and of Alternatives

2 and 4. It should be noted that comparing the high estimate in Alternative 1 to the low estimate for Alternative 2 or Alternative 4 is somewhat akin to comparing apples and oranges because the high and low outcomes are based on different assumptions. Pragmatically, the difference between the high and low cases of Alternative 1 is small compared to that of the other alternatives, so that comparing the high case of Alternative 1 to the low cases of the other alternatives would not produce significantly different results or conclusions.

4.12.2.1.2 Methodology

Estimates of regional impacts of the groundfish were developed from profiles of fishing and processing sectors.¹ The fishing and processing profiles classify the participants in the fisheries into classes of vessels and processors that have similar participation patterns in the groundfish fisheries. Within each class profile, data are provided indicating the number of vessels and processors in each class associated with each of the regions. Often the number of vessel or processors in a class that are associated with each region is small and confidentiality becomes a serious constraint. The estimation of regional impacts therefore starts with the assumption that each vessel or processor in the class associated with each region operates at the average for the class. If two longline catcher processors are associated with the Kodiak Region, the impact of those vessels is assumed to be equal to two times the average impact of a single longline catcher processors. Confidentiality restrictions would prevent disclosure of the actual impact of longline catcher processors because there are fewer than three vessels. Because the average impact of a longline catcher processor is based on the entire fleet of longline catcher processors, the disclosure of average impacts is not confidential. That said however, it should be noted that there are regional differences in productivity. For example, in the Kodiak region the estimated impact of all harvest vessels based on the averages for each class multiplied by the number of each class associated with the Kodiak region is approximately 10 percent less than the actual impact of all harvest vessels.

To account for these region productivity differences, the "normalized" estimates based on class averages are adjusted to ensure that the estimated total regional impacts are correct. The adjustment factor changes from year to year depending on changes in prices, species mixes, and migration patterns of vessel and processor owners. For the estimated impacts of the alternatives, the regional adjustment factor from the 1999 fishery are used. However, because the alternatives affect only a portion of the groundfish fishery and use a combination of 1999 fishing and processing patterns, 2000 prices, and 2001 TACs and ABCs, the regional adjustment factors create a small and relatively insignificant error factor. This error factor is most noticeable when the total harvest for all regions is compared to the total harvest for the alternative from other sections of the analysis—the two total harvest estimates are slightly different. While this error factor is somewhat troublesome, the analysts believe that without the regional productivity adjustment factor the analysis would significantly skew the impacts across the various regions. Table 4.12-0 shows the regional productivity adjustment factor used for harvesting and processing facilities owned by regional residents. If the adjustment factor had not been applied, then in Kodiak, for example, the catcher vessel impacts owned by residents would have been underestimated by 26 percent, and the impacts from regionally owned processors would have been overestimated by 82 percent.

¹An earlier version of these profiles were included as Appendix I in the Programmatic Groundfish SEIS (NMFS 2001a). The updated version of these profiles are attached to this draft Steller Sea Lion Protection Measures SEIS.

Table 4.12-0 Regional productivity adjustment factor for 1999

Regions	AKAPAI	AKKO	AKSC	AKSE	WAIW	ORCO	OTHER
Catcher Vessels	91%	126%	71%	88%	99%	104%	109%
Processors	3%	55%	81%	67%	107%	0%	65%

4.12.2.2 Effects Analysis, by Region and Alternative

4.12.2.2.1 Alaska Peninsula/Aleutian Islands Region

Alternative 1 - Baseline Conditions

The Alaska Peninsula/Aleutian Islands region participates in the Alaskan groundfish fishery primarily through the large shore plants located in the region (but for the most part with ownership outside of the region) and regionally owned catcher vessels. The economic importance to regional communities and the Aleutians East Borough (payments to labor, employment, taxes paid) of the shoreplants are much greater than those of the regionally owned vessels (Table 4.12-2). Potential Alaska Peninsula/Aleutian Islands regional effects of Alternatives 2 and 4 are discussed in terms of the five measures discussed in the introduction, since the offshore sector has no regional ownership (although it must be noted that this sector pays a substantial amount of state, borough, and city taxes and also generates local employment through the support service sector in local communities). While Pacific cod is a significant component of the groundfish fishery, pollock by far comprises the majority (76 percent by value and 87 percent by volume in 1999) of the groundfish harvested and processed in the region. The high-case and the low-case for Alternative 1 for the Alaska Peninsula/Aleutian Islands region differ by 1 to 2 percent in total, and so are essentially equivalent. In terms of species, pollock differed by about 1 percent and Pacific cod by about 2 percent, while Atka mackerel measures can vary substantially due to relatively small absolute changes in harvest amounts and prices.

Alternative 2

As a measure of uncertainty, the high and low case totals for Alternative 2 (Table 4.12-11) differ by 40 to 60, although percentage changes for species generally vary within the more restricted range of 39 to 49 percent for all measures except tons of groundfish harvested by regionally-owned catcher vessels. Generally, the percentage differences are greater for Pacific cod than for pollock. The exceptions are for the harvest (and associated payments) for locally owned catcher vessels and for regionally owned at-sea processors. For the former, the total difference between the high and low cases is 60 percent, 78 percent for pollock and 35 percent for Pacific cod. For regionally-owned at-sea processors, the total difference is 18 percent, with a 44 percent difference for pollock and a 16 percent difference for Pacific cod (and 57 percent for Atka mackerel). In terms of ex-vessel value paid by shore based processors, the total difference between the two cases is 41 percent, 39 percent for pollock and 47 percent for Pacific cod. The difference in total shore based processing tons is 40 percent – 39 percent for pollock and 49 percent for cod. Total harvesting and processing payments to labor differ by 40 percent, 39 percent for pollock and 47 percent for Pacific cod. Employment differences mirror payments to labor. Thus, as is the general case, uncertainty of the amount of fish to be harvested and/or processed by regionally owned fishery participants, or regional onshore processors, is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Alaska Peninsula/Aleutian Islands region the uncertainty under Alternative 2 associated with the Pacific cod fishery is somewhat greater than that for the pollock fishery.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-13. For the high-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 55 percent (55 for pollock and 55 for cod). In order to put these declines in context, they must be compared to the relevant vessel measures for the regional fisheries in general, and for the overall groundfish fishery in the region in particular for the participating entities. (This caveat applies to the parallel discussion for other alternatives and regions as well.) Given that in recent years groundfish accounted for roughly half of the total harvest diversity of these vessels, and that pollock and Pacific cod accounted for over 99 percent of volume and 96 percent of value of the groundfish harvest of these vessels in 1999, this is a very substantial decline. The total ex-vessel value paid by shore based processors in the region is projected to decrease 34 percent for combined pollock and Pacific cod – 30 percent for pollock and 48 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (32 percent in general, 30 percent for pollock, and 48 percent for cod). As was the case for the catcher vessel measures, in order to put these declines in context, they must be compared to the relevant processor measures for the regional fisheries as a whole, and for the overall groundfish fishery in the region in particular for the participating entities. Given that for the larger shoreplants in the region, groundfish in recent years accounted for about 50 percent of volume and 60 percent of value overall, and that Pacific cod and pollock combined accounted for 98 percent of volume and product value reported for groundfish for 1999, these are again very substantial declines. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region would change by about the same amount (33 percent in total, 30 percent for pollock and 47 to 48 percent for cod).

For the low-case of Alternative 2, the results are even more extreme. The total combined pollock and Pacific cod harvested by regionally owned catcher vessels would decline by about 82 percent (90 for pollock and 70 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 60 percent for combined pollock and Pacific cod – 57 percent for pollock and 72 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (59 percent in general, 57 percent for pollock, and 73 percent for cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about the same amount (60 percent in total, 57 percent for pollock and 71 to 72 percent for cod).

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce Alaska Peninsula/Aleutian Islands participation in the groundfish fishery by 30 to 57 percent for pollock and by 47 to 72 percent for Pacific cod, or about 32 to 60 percent combined. Given the relative dependency upon the groundfish fishery in general, and the pollock and Pacific cod components of the fishery in particular, this would result in significant impacts to those communities in the region engaged in the fishery. This would have profound effects upon local communities with large groundfish processing plants - Unalaska, Akutan, King Cove, and Sand Point. Each of these communities would be expected to experience impacts in the fisheries related sector of the economy in particular, but impacts would be felt in other sectors of the local economy as well. The degree to which other sectors would decline depends upon the relative level of integration of the processing and harvesting sectors with the rest of the community economy and the diversity within the fisheries specific portion of the economy. Fisheries related local government revenues would also decline significantly, with the specific amount depending on the local tax structure. Unalaska, with its substantial support service sector, would experience additional impacts. The Aleutians East Borough as a jurisdiction would also experience significant impacts through loss of fishery related revenue. This would be felt in all borough communities, as communities without major groundfish plants (Cold Bay, False Pass, and Nelson Lagoon) normally benefit from borough expenditures that are made possible by collection of fishery related revenue in communities with major groundfish plants (Akutan, King Cove, and Sand Point). As noted in the cumulative impacts discussion (Section 4.13.13), a number of the Aleutians East Borough

communities are currently experiencing other adverse fishery impacts, such as in the Area M salmon fishery and the declines in the crab fisheries. While AFA impacts have been generally positive for the borough, they have been negative for Sand Point. Unalaska is experiencing a downturn in the crab fishery like the Aleutians East Borough, but unlike the borough it is not a large participant in the salmon fishery. While generally benefitting from AFA conditions, Unalaska has seen a downturn in its support service sector related to AFA-created conditions (among other factors). The adverse cumulative conditions noted for the Aleutians East Borough and Unalaska would tend to exacerbate the negative impacts of Alternative 2.

Alternative 4

The high and low case totals for Alternative 4 (Table 4.12-32) generally differ by 4 to 12 percent for the measures of interest (4 percent for pollock, 10 to 11 percent for Pacific cod), except for retained harvest by regionally owned catcher vessels (12 percent for pollock, 13 percent for Pacific cod). This range is greater than for the baseline (Alternative 1), but is substantially less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. The Pacific cod fishery is more uncertain than is the pollock fishery.

Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-34. For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 8 percent (all due to a 20 percent decrease in the Pacific cod harvest). The total ex-vessel value paid by shore based processors in the region is projected to decrease 1 percent for pollock and Pacific cod combined – again all due to a 4 percent decrease for cod. Shore based processing of combined pollock and Pacific cod in terms of weight is also projected to remain about the same (a 4 percent decrease in cod, but little change in the regional total). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change only by 1 percent, again due to a 4 to 5 percent decrease attributable to a slightly smaller volume of cod being processed.

For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 18 percent (11 for pollock and 29 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 5 percent for combined pollock and Pacific cod – 3 percent for pollock and 12 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (4 percent in general, 3 percent for pollock, and 11 percent for cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about the same amount (5 percent in total, 3 percent for pollock and 13 percent for cod).

Thus, while Alternative 4 would have some effects upon Alaska Peninsula/Aleutian Islands participation in the fishery and upon local communities, for the most part such effects would be expected to be no worse than those experienced from "normal" fluctuations in the fishery. In particular, the large shore based plants that process large volumes of pollock would be affected primarily in terms of Pacific cod. While cod is important in their operations, it is secondary to pollock. Effects on regional employment, and on the local tax base, would be in the 5 percent range for groundfish related positions and revenue, but would not be nearly as great as those projected for Alternative 2. Further, this would not result in an overall 5 percent decline on these indices within individual communities, given the importance of other fisheries to employment and the tax base.

Alternative 4 with Option 2

Option 2, the Unalaska/Dutch Harbor small boat exemption, would establish a limited fishing zone for Pacific cod within the Area 9 (Bogoslof) exclusion area for jig and longline catcher vessels less than 60'. Fishing in this zone would have a harvest cap of 250,000 lbs. of Pacific cod. The area, fully described in the description of alternatives in Section 2, is shown in Figure 4.12-1 and includes a 10 nautical mile radius closure around the Bishop Point haulout.

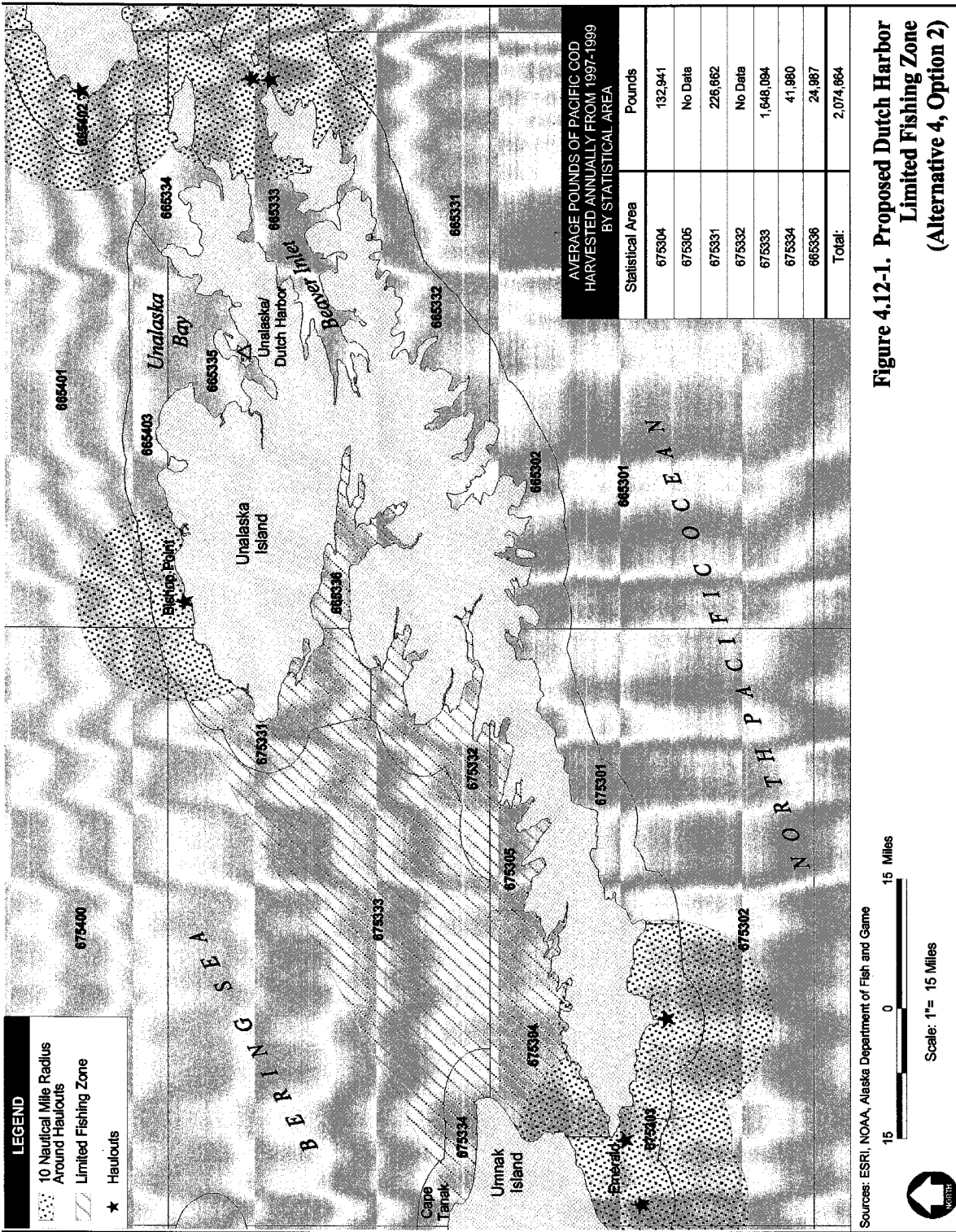


Figure 4.12-1. Proposed Dutch Harbor Limited Fishing Zone (Alternative 4, Option 2)

Steller Sea Lion SEIS
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As noted in the 'links to the groundfish fishery,' harvesting component, portion of Unalaska community discussion in Section 1.1 of Appendix F(1), between 3 and 21 Unalaska resident owned vessels under 60' have had landings in targeted groundfish fisheries in any given year from 1992 to 2000. While data are not readily available to document the proportion of local catch that has come out of the proposed limited fishing area, the total value of groundfish ex-vessel revenues for the community based fleet from all areas ranged between \$40,000 to \$250,000 per year (for that years that can be disclosed) during this same time period. The number of vessels during this era peaked at 21 in 1996, and has declined every year since, with 7 active vessels remaining 2000, or a total reduction of 67 percent in fleet size from 1996 to 2000. At the same time, total ex-vessel value has also been declining but at a slower rate (from \$150,000 in 1996 to \$100,000 in 2000), with the result that the average ex-vessel value has doubled for the remaining vessels, from \$7,100 per vessel in 1996 to \$14,300 per vessel in 2000. Among the groundfish species, Pacific cod plays a dominant role for these vessels. Between 1992 and 2000, Pacific cod accounted for 71 and 100 percent of value of catch for this fleet in any given year, with an average of 92 percent per year over this span. Over the most recent four years, 1997 through 2000, Pacific cod accounted for 89 percent of total value of catch for the Unalaska-owned under 60' fleet. There is no state water groundfish fishery in the Bering Sea near the community, so these data all refer exclusively to federal water fisheries. Of the 7 vessels participating in the 2000 fishery, all were fixed gear vessels. Two were in the 33-59' FGCV class, and three were in the less than or equal to 32' FGCV class, while the remaining two did not make enough landings to be classified into any specific gear class (i.e., they were categorized as "ghost vessels"). During the 1993 to 1998 period, 95 percent of Pacific cod landed by Unalaska owned vessels under 60' were caught using jig gear. In 1999 and 2000, the proportion of catch by vessels using longline gear increased significantly, but specific figures cannot be disclosed due to confidentiality restrictions, given that only two local vessels using longline gear reported catch in each of these two years.

In attempting to ascertain the likely social impacts of Option 2, it is also important to note that (1) there are a number of vessels not owned by community residents in the under 60' class that deliver to Unalaska (and Beaver Inlet) processors, and (2) that the Unalaska small boat exemption under Option 2 of Alternative 4 cannot and would not apply only to vessels based in any particular local community or set of communities. As discussed in Appendix F(1), Section 1.1, for fixed gear vessel class 33-59' for 2000, the value of Unalaska Island deliveries for this sector alone (\$1.23 million) is about 12 times higher than the total ex-vessel revenues for all Unalaska/Dutch Harbor resident owned under 60' vessel classes combined for the same year (\$0.10 million). These data would indicate that if historical and contemporary data are a guide, effort many times greater than that represented by the local fleet (as measured by community residence of the owner) could be directed toward that exclusion area. Therefore, the 'benefit' of a small boat exemption zone would not accrue exclusively, or perhaps even mostly, to Unalaska /Dutch Harbor owned vessels (but the data to parse out these potential impacts are not readily available). Further, recent historic and contemporary data suggest that additional effort could be directed toward the limited fishing zone by new vessels coming to the area, given the apparent existing level and patterns of use of area waters by non-locally owned vessels. While it may be the case the Unalaska/Dutch Harbor owned small vessels do not fish far from the community, it is clear from the landings data that small vessels in these same gear classes from other communities fish far from their owner's communities (i.e., they travel to fish, or at least land fish, in the Unalaska/Dutch Harbor area). As discussed in Appendix F(1) Section 1.4, for Pacific cod specifically, in 1999, a total of 14 fixed gear vessels under 60' reported Pacific cod Bering Sea targeted landings (contrasted to the subset of 9 Unalaska owned vessels that same year), and in 2000, 23 vessels in that same class reported Bering Sea Pacific cod landings (compared to the subset of 7 Unalaska owned vessels in that same year). In 1999, total ex-vessel value was only slightly higher for the combined Bering Sea under 60' fixed gear fleet than for the Unalaska owned vessels alone, but in 2000 the combined ex-vessel value was almost double that of the Unalaska owned segment of the fleet. In other words, there is great variability from year to year, and

the non-Unalaska/Dutch Harbor based vessels could account for a great deal of the effort directed toward any Unalaska small boat exception limited fishing zone.

Figure 4.12-1 provides data on average annual Pacific cod landings for 1997-1999 from the statistical areas in part or in whole within the proposed Dutch Harbor limited fishing zone. These data encompass all vessel size and gear type classes, and do not provide information on landings inside and outside the limited fishing zone area within those statistical areas that only fall partially within the zone itself. Given that only two locally owned vessels under 60' reported Pacific cod landings using longline gear, no analysis of differential use of this area by local jig and longline vessels can be reported, due to data confidentiality restrictions. Nevertheless, these area data do provide a rough gauge of the relative importance of these statistical areas to the area Pacific cod fishery.

As noted in Appendix F(1), the small boat fleet in Unalaska accounts for very little overall catch compared to the industrial scale fishery activity that takes place in the community. For example, the total groundfish ex-vessel value for small boat fleet in 2000 was \$100,000; in contrast, the total value of processed groundfish in Unalaska/Dutch Harbor was \$92,288,000 in 2000, or 923 times the value landed by the locally owned under 60' fleet. Given this difference in scale, Option 2 would have little impact on the community as a whole. For the limited number of vessels that are owned by community residents, however, this option could be of benefit for individual catcher vessel operations, and the two small processing operations that primarily work with this fleet. Data to quantify these beneficial impacts beyond a general level are not readily available, and it is clear that benefits from this option would not accrue exclusively to the Unalaska owned fleet.

4.12.2.2 Kodiak Region

Alternative 1 - Baseline Conditions

The Kodiak region participates in the Alaskan groundfish fishery primarily through the large shore plants located in the region (but for the most part with ownership outside of the region) and regionally owned catcher vessels. The economic importance to regional communities and the Kodiak Island Borough (payments to labor, employment, taxes paid) of the shoreplants are greater than those of the catcher vessels (Table 4.12-3), but these measures understate the economic importance of the fleet in terms of support and indirect economic benefits. Potential Kodiak regional effects of Alternatives 2 and 4 are discussed in terms of the five measures discussed in the introduction, since the offshore sector has fairly low regional ownership and generates little regional employment (other than for Atka mackerel). More pollock than cod is harvested and processed, but cod generates more economic value. Also, unlike other regions (with the exception of the Washington Inland Waters region) Atka mackerel harvest and processing levels are not insubstantial, and this is concentrated nearly exclusively in the catcher-processor sector. The high-case and the low-case for Alternative 1 for the Kodiak region differ by about 1 percent in total (1 percent for pollock, 1 to 2 percent for Pacific cod), and so are essentially equivalent.

Alternative 2

As a measure of uncertainty, the high and low case totals for Alternative 2 (Table 4.12-14) differ by 33 to 62 percent, depending on the measure, with greater percentage differences associated with pollock than with Pacific cod. For instance, the difference in the harvest of locally owned catcher vessels is 44 percent, with a 52 percent difference for pollock and a 28 percent difference for Pacific cod. In terms of ex-vessel value paid by shore based processors, the total difference between the two cases is 43 percent, 85 percent for

pollock and 16 percent for Pacific cod. The difference in total shore based processing tons is 62 percent -- 85 percent for pollock and 18 percent for cod. In terms of regionally-owned processed value the difference is 33 percent, 70 percent for pollock and 16 percent for Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor differ by 20 percent, 70 percent, and 57 percent, respectively. Employment differences mirror payments to labor. Thus, as is the general case, uncertainty of the amount of fish to be harvested and processed is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Kodiak region, the uncertainty associated with the pollock fishery is much higher than that associated with the Pacific cod fishery.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-16. For the high-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 41 percent (41 for pollock and 42 for cod). As for the relative importance of this decline to the overall operations of the participants, given that in recent years groundfish accounted for somewhat less than half of the ex-vessel value to these vessels, and that pollock and Pacific cod accounted for 89 percent of the volume and 83 percent of the value of all groundfish to these vessels in 1999, this is a substantial decline. The total ex-vessel value paid by shore based processors in the region is projected to decrease 50 percent for combined pollock and Pacific cod -- 55 percent for pollock and 46 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (52 percent in general, 55 percent for pollock, and 46 percent for cod). As for the relative value to overall operations, given that groundfish in recent years has been approaching half of the overall value at these plants, and that Pacific cod and pollock combined represented 81 percent of volume and 85 percent of total groundfish product value in 1999, these are also substantial declines. Total Pacific cod, pollock and Atka mackerel related harvesting and processing payments to labor accruing to the region change by 45 percent in total, 50 percent for pollock and 41 percent for cod.

For the low-case of Alternative 2, results are more extreme. Total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 67 percent (71 for pollock and 57 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 71 percent for combined pollock and Pacific cod -- 93 percent for pollock and 54 percent for cod. Shore based processing of pollock and Pacific cod combined is projected to decrease by a greater percentage (82 percent in general, 93 percent for pollock, and 55 percent for cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about 67 percent in total, 85 percent for pollock and 52 percent for cod. Employment mirrors payments to labor.

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce Kodiak participation in the groundfish fishery by 41 to 93 percent for pollock and by 41 to 58 percent for Pacific cod, or about 41 to 82 percent combined. This would have significant socioeconomic effects upon the region, and especially the community of Kodiak, given the local engagement in, and dependency upon the groundfish fishery.

Alternative 4

The high and low case totals for Alternative 4 (Table 4.12-35) differ by 9 to 10 percent for the measures of interest (7 to 10 percent for pollock, 9 to 13 percent for Pacific cod). This is greater than for the baseline (Alternative 1), but is significantly less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. The uncertainty is about the same for both the pollock and Pacific cod fisheries.

Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-37 (recalling that relative dependency on groundfish in general and on Pacific cod and pollock in particular for regional harvesters and processors are as described in the Alternative 2 discussion [i.e., change figures described here are not changes for the total volume and value for either the total combined fisheries or for all groundfish fisheries]). For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels does not change in total, and only 1 percent for Pacific cod. The total ex-vessel value paid by shore based processors in the region is projected to decrease 3 percent for pollock and cod combined – all due to a 6 percent decrease for cod. Shore based processing of combined pollock and Pacific cod in terms of weight is also projected to remain about the same – a 1 percent decrease, due to a 5 percent decrease associated with Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change only by 2 percent, again due to a 3 percent decrease attributable to a slightly smaller volume of cod being processed.

For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 8 percent (7 for pollock and 11 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 12 percent for pollock and Pacific cod combined – 10 percent for pollock and 14 percent for cod. Shore based processing of groundfish is also projected to decrease by about the same amount (11 percent for combined pollock and Pacific cod, 10 percent for pollock, and 13 percent for cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about the same amount (10 percent in total, 9 percent for pollock and 12 percent for cod).

Thus, while Alternative 4 would have some effects upon Kodiak regional participation in the fishery and upon local communities, such effects may be comparable to those experienced from “normal” fluctuations in the fishery. Pacific cod operations are likely to be somewhat more affected than are those more dependent on pollock, but most Kodiak operations use both (with the exception of longline catcher-processors). Effects on regional employment, and on the local tax base, would be significant (up to 10 or 12 percent) for Pacific cod, pollock, and Atka mackerel related jobs and revenues specifically, but this would be an overall fisheries sector reduction of perhaps one-half that amount, taking into account existing harvesting and processing diversity within the local fisheries. While still potentially significant, it would not be nearly as great as those projected for Alternative 2.

4.12.2.2.3 Alaska Southcentral Region

Alternative 1 - Baseline Conditions

The Alaska Southcentral region participates in the Alaskan pollock and Pacific cod groundfish fisheries at a relatively low level through ownership in several sectors -- catcher vessels, shore based shore plants, and offshore catcher-processors (Table 4.12-4). Potential Alaska Southcentral regional effects of Alternatives 2 and 4 are discussed in terms of the five measures discussed in the introduction, with a mention of offshore linkages as well. Again, the overall magnitude of the combined pollock and Pacific cod effects in this region is relatively small, especially given the overall size of the regional economy. Pacific cod has more economic value in this region than pollock. The high-case and the low-case for Alternative 1 for the Alaska Southcentral region differ by about 1 percent, and so are essentially equivalent.

Alternative 2

As a measure of uncertainty, the high and low cases for Alternative 2 (Table 4.12-17) differ by 14 to 28 percent, depending on the measure, with greater percentage differences associated with pollock than with Pacific cod. For instance, the difference in the harvest of locally owned catcher vessels is 28 percent, with a 62 percent difference for pollock and a 14 percent difference for Pacific cod. In terms of ex-vessel value paid by shore based processors, the total difference between the two cases is 14 percent, 36 percent for pollock and 11 percent for Pacific cod. The difference in total shore based processing tons is 19 percent -- 36 percent for pollock and 11 percent for cod. In terms of regionally owned processed value the difference is 26 percent, 58 percent for pollock and 17 percent for Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor differ by 14 percent, 44 percent, and 0 percent, respectively. Employment differences mirror payments to labor. Thus, as is the general case, uncertainty of the amount of fish to be harvested and processed is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Alaska Southcentral region, the uncertainty associated with the pollock fishery is much higher than that associated with the Pacific cod fishery for Alternative 2.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-19. For the high-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 38 percent (46 for pollock and 35 percent for cod). As for overall importance to the participants, given that in recent years groundfish accounted for approximately one-quarter of total ex-vessel value for these vessels, and that pollock and Pacific cod accounted for 88 percent of volume and 63 percent of value of the groundfish harvest by these vessels in 1999, this represents a significant decline for these vessels. The total ex-vessel value paid by shore based processors in the region is projected to decrease 40 percent for combined pollock and Pacific cod -- 56 percent for pollock and 37 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (43 percent in general, 56 percent for pollock, and 34 percent for cod). Given that groundfish accounted for slightly less than one-third of the total ex-vessel value at these plants in recent years, and that in 1999 pollock and Pacific cod accounted for 50 percent of total groundfish volume and 30 percent of product value at these plants, this represents a significant impact to this sector. Total regionally owned processing production value for pollock and Pacific cod combined would decline by 32 percent (48 percent for pollock, 25 percent for Pacific cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region decline by 30 percent, 49 percent for pollock and 25 percent for cod.

For the low-case of Alternative 2, the results are even more extreme. Total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 55 percent (79 for pollock and 43 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 49 percent for combined pollock and Pacific cod -- 71 percent for pollock and 44 percent for cod. Shore based processing of pollock and Pacific cod combined is projected to decrease by a greater percentage (54 percent in general, 71 percent for pollock, and 41 percent for cod). Regionally owned processing production value would decline 50 percent, 77 percent for pollock and 37 percent for Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about 42 percent in total, 72 percent for pollock and 35 percent for cod. Employment mirrors payments to labor.

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce Alaska Southcentral participation in the groundfish fishery by 46 to 79 percent for pollock and by 25 to 44 percent for Pacific cod, or about 30 to 55 percent combined. This would have severe effects upon individual operations, some with connections with operations in other regions. Community level effects would be

minimal, however, due to the relatively small role of the pollock and Pacific cod fisheries in the regional economy in general, and Pacific cod and pollock in the overall fisheries economies of local communities in particular. Pollock operations would be more strongly affected than would those concentrating on Pacific cod, but pollock has a much lower total processed product value and total catcher vessel ex-vessel value in this region than does Pacific cod (by factors of 2 and 10, respectively).

Alternative 4

The high and low case totals for Alternative 4 (Table 4.12-38) differ by 5 to 12 percent for the measures of interest (4 to 8 percent for pollock, 6 to 14 percent for Pacific cod). This is greater than for the baseline (Alternative 1), but is significantly less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. The uncertainty is about the same for both the pollock and Pacific cod fisheries for Alternative 4.

Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-40 (recalling that relative dependency on groundfish in general and on Pacific cod and pollock in particular for regional harvesters and processors are as described in the Alternative 2 discussion [i.e., change figures described here are not changes for the total volume and value for either the total combined fisheries or for all groundfish fisheries]). For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels increases by 4 percent, due to a 6 percent increase for Pacific cod. The total ex-vessel value paid by shore based processors in the region is projected to increase by 1 percent – due to a 1 percent decrease for pollock and a 2 percent increase for Pacific cod. Shore based processing of pollock and Pacific cod combined in terms of weight is also projected to increase 3 percent, due to a 1 percent decrease associated with pollock, but a 6 percent increase associated with Pacific cod. Total regionally owned processing product value is projected to be unchanged, with a 1 percent decline in that of Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region would increase by 2 percent, again due to a 3 percent increase attributable to cod. Employment increases are somewhat larger.

For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 8 percent (8 for pollock and 8 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 4 percent for combined pollock and Pacific cod – 4 percent for pollock and 4 percent for cod. Shore based processing of pollock and Pacific cod combined is also projected to decrease by about 2 percent in general, 4 percent for pollock, and 1 percent for cod). Total regionally owned processor product value is projected to decrease by 8 percent (7 percent for pollock, 8 percent for Pacific cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about 5 percent in total, 6 percent for pollock and 5 percent for cod). Employment declines are projected as somewhat smaller.

Thus, while Alternative 4 would have some effects upon Alaska Southcentral regional participation in the fishery and upon local communities, such effects are likely to be minor to somewhat negative, and may be comparable to those experienced from "normal" fluctuations in the fishery. Pollock operations are likely to be somewhat more affected than are those more dependent on Pacific cod. Effects on regional employment, and on the local tax base, would not be likely to be significant.

4.12.2.2.4 Alaska Southeast Region

Alternative 1 - Baseline Conditions

The Alaska Southeast region participates in the Alaskan pollock and Pacific cod fisheries at a somewhat higher level than does the Alaska Southeast region through ownership in several sectors – catcher vessels, shore based shore plants, and offshore catcher-processors (Table 4.12-5). Potential Alaska Southeast regional effects of Alternatives 2 and 4 are discussed in terms of the five measures discussed in the introduction, with a mention of offshore linkages as well. Again, the overall magnitude of the combined pollock and Pacific cod effects in this region is relatively small. The high-case and the low-case for Alternative 1 for the Alaska Southeast region differ by about 1 percent, and so are essentially equivalent.

Alternative 2

As a measure of uncertainty, the high and low case totals for Alternative 2 (Table 4.12-20) differ by 9 to 18 percent, depending on the measure, with greater percentage differences associated with pollock than with Pacific cod. For instance, the total difference in the harvest of locally owned catcher vessels is 18 percent, with a difference of 77 percent for pollock and an 12 percent difference for Pacific cod. In terms of ex-vessel value paid by shore based processors, the total difference between the two cases is 9 percent, 10 percent for pollock and 9 percent for Pacific cod. The difference in total shore based processing tons is 9 percent – 10 percent for pollock and 9 percent for cod. In terms of regionally owned processed value the difference is 14 percent, 15 percent for pollock and 14 percent for Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor differ by 13 percent, 33, and 0 percent, respectively. Employment differences mirror payments to labor. Thus, as is the general case, uncertainty of the amount of fish to be harvested and processed is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Alaska Southeast region, the uncertainty associated with the pollock fishery is much higher than that associated with the Pacific cod fishery for Alternative 2, for processors. For catcher vessels, Pacific cod uncertainty is greater. Both are regionally important, but are small components of the overall Alaskan groundfish fishery.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-22. For the high-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 40 percent (55 for pollock and 38 percent for cod). Given that in recent years groundfish accounted for between 30 and 40 percent of ex-vessel value to these vessels, and that in 1999, Pacific cod accounted for 30 percent of the volume and 6 percent of total ex-vessel value for all groundfish to these vessels (pollock contribution to volume and value was insignificant), the decline in value in relation to total vessel operations is not likely to be significant. The total ex-vessel value paid by shore based processors in the region is projected to decrease 38 percent for combined pollock and Pacific cod – 56 percent for pollock and 38 percent for cod. Shore based processing of combined pollock and Pacific cod is also projected to decrease by about the same amount (38 percent in general, 56 percent for pollock, and 38 percent for cod). Given that in recent years groundfish accounted for roughly 30 percent of ex-vessel value at these plants, and in 1999 Pacific cod accounted for only 2 percent of volume and less than 1 percent of product value for all groundfish (pollock totals were not significant), the decrease associated with this alternative is not likely to be significant. Total regionally owned processing production value for Pacific cod and pollock would decline by 16 percent (19 percent for pollock, 16 percent for Pacific cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region decline by 26 percent, 34 percent for pollock and 26 percent for cod, but these declines are relatively small in absolute terms.

For the low-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 47 percent (90 for pollock and 44 for cod). The total ex-vessel value paid by shore based processors in the region is projected to decrease 42 percent for combined pollock and Pacific cod – 41 percent for pollock and 41 percent for cod. Shore based processing of combined pollock and Pacific cod is projected to decrease by the same percentage (41 percent in general, 41 percent for pollock, and 41 percent for cod). Regionally owned processing production value for pollock and Pacific cod combined would decline 32 percent, 40 percent for pollock and 27 percent for Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about 38 percent in total, 41 percent for pollock and 35 percent for cod. Employment mirrors payments to labor. As in the instance of the high-case of Alternative 2, however, these declines are relatively minor in absolute terms and in comparison to the groundfish harvesting and processing sectors in this region, the overall harvesting and fisheries sectors in this region, and the local economies and overall economy of this region.

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce Alaska Southeast participation in the combined pollock and Pacific cod fishery by 19 to 90 percent for pollock (with the higher number applicable only to the few locally owned catcher vessels harvesting pollock) and by 26 to 44 percent for Pacific cod, or about 21 to 47 percent in general. This could have marked effects upon individual operations, but in general engagement in and dependence upon the pollock and Pacific cod fisheries is relatively low for communities in this region and for the region as a whole. Pollock operations would be more severely affected than would those concentrating on Pacific cod. Community effects could also be significant for those few regional communities with shore plants processing relatively large amounts of pollock, otherwise, this alternative is not likely to result in significant impacts at the community level in this region.

Alternative 4

The high and low cases for Alternative 4 (Table 4.12-41) differ by 5 to 9 percent for the measures of interest (7 to 12 percent for pollock, 5 to 9 percent for Pacific cod) – excluding shoreplant measures. This is somewhat greater than for the baseline (Alternative 1), but is significantly less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to “normal” risk than is that of Alternative 2. The uncertainty is greater for pollock than for Pacific cod fisheries for Alternative 4. This indicates that the greater the degree of restriction on fishing, the greater the uncertainty imposed on the pollock fishery in comparison to the Pacific cod fishery.

Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-43 (recalling that relative dependency on groundfish in general and on Pacific cod and pollock in particular for regional harvesters and processors are as described in the Alternative 2 discussion [i.e., change figures described here are not changes for the total volume and value for either the total combined fisheries or for all groundfish fisheries]). For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels increase by 1 percent, due to a 1 percent increase for Pacific cod. The total ex-vessel value paid by shore based processors in the region is unchanged. Shore based processing of combined pollock and Pacific cod in terms of weight is also projected not to change. Total regionally owned processing product value is projected to increase 1 percent, with a 1 percent increase in that of Pacific cod. Total harvesting and processing payments to labor accruing to the region would be unchanged.

For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 8 percent (11 for pollock and 7 for cod). The total ex-vessel value paid by

shore based processors in the region is not projected to decrease for combined pollock and Pacific cod – with a decrease of only 1 percent for pollock and 0 percent for cod. Shore based processing of pollock and Pacific cod combined is also not projected to decrease in general, all due to only a 1 percent decrease for pollock. Total regionally owned processor product value is projected to decrease by 2 percent (2 percent for pollock, 2 percent for Pacific cod). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by about 4 percent in total, 6 percent for pollock and 4 percent for cod). Employment declines mirror payments to labor.

Thus, while Alternative 4 would have some effects upon Alaska Southeast participation in the fishery and upon local communities, such effects are likely to be minor to somewhat negative, and may be comparable to those experienced from “normal” fluctuations in the fishery. Pollock operations are likely to be more affected than are those more dependent on Pacific cod. Effects on regional employment, and on the local tax base, would also appear to be in the range of past “normal” fluctuations.

4.12.2.2.5 Washington Inland Waters Region

Alternative 1 - Baseline Conditions

The Washington Inland Waters region participates in the Alaskan groundfish fishery through ownership interests in groundfish processing facilities (shore plants located in Alaska, catcher-processors based for the most part in the state of Washington, and motherships based in the state of Washington) and ownership of catcher vessels participating in the groundfish fishery (Table 4.12-6). The Washington Inland Waters region, in fact, represents a great majority of the groundfish processing ownership, and a large percentage for participating catcher vessels. Potential Washington Inland Waters regional effects of Alternatives 2 and 4 are discussed in terms of the five measures discussed in the introduction, with the addition of measures related to catcher-processors and motherships. Pollock and cod are the two most important components of the Washington Inland Waters groundfish fishery, but pollock is by far the more significant in terms of weight and value. Also, unlike other regions (with the exception of Kodiak) Atka mackerel harvest and processing levels are significant, and this is concentrated nearly exclusively in the catcher-processor sector. The high-case and the low-case for Alternative 1 for the Washington Inland Waters region differ by 1 to 3 percent for pollock and Pacific cod, and so are essentially equivalent (differences for Atka mackerel are 22 to 25 percent).

Alternative 2

As a measure of uncertainty, the high and low case totals for Alternative 2 (Table 4.12-23) differ by about 17 percent for regionally-owned at-sea processors, 26 percent for all regionally-owned processors, and 35 percent for the one regional catcher vessel measure, with about equal percentage differences associated with pollock and Pacific cod for processor measures. For instance, the total difference in the harvest of locally owned catcher vessels is 35 percent, with a difference of 34 percent for pollock and a 47 percent difference for Pacific cod (and 53 percent for Atka mackerel). In terms of the value of product processed by all regionally owned processors, the difference is 26 percent, 26 percent for pollock and 26 percent for Pacific cod. Regionally owned at-sea product value differs by 17 percent. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor differ by 23 percent, 23 percent, and 57 percent, respectively. Employment differences mirror payments to labor. Thus, as is the general case, uncertainty of the amount of fish to be harvested and processed is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Washington Inland Waters region, the uncertainty associated with

the pollock and Pacific cod fisheries under this alternative is about the same, except perhaps for regional catcher vessel owners.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-25. For the high-case of Alternative 2, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 28 percent (27 for pollock, 49 percent for cod – Atka mackerel also declines but in absolute terms is an insignificant portion of the total). Given that in recent years groundfish accounted for roughly 60 percent of the total harvest diversity ex-vessel value for these vessels, and that pollock and Pacific cod and that in 1999 pollock and cod accounted for 98 percent of volume and 88 percent of the ex-vessel value of all groundfish for these vessels, this is a substantial decline. In terms of the total of regionally owned processor's value (at-sea and shore-based combined), the difference is 26 percent, 24 percent for pollock and 32 percent for Pacific cod. These again are very large decreases, considering the very high concentration of processor ownership for the overall North Pacific groundfish fishery within this region, and the relative importance of these two groundfish species to those operations. Regionally owned at-sea product value would decrease by 20 percent under this alternative. While this is somewhat less of a decrease than seen for other sectors under this alternative, it remains significant and represents a large decline in absolute terms. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region decrease by 24 percent in total, 22 percent for pollock and 27 percent for cod.

For the low-case of Alternative 2, declines are even more extreme. Total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 52 percent (51 for pollock, 72 percent for cod). In terms of the value of product processed by regionally owned processors, the difference is 44 percent, 43 percent for pollock and 49 percent for Pacific cod. Regionally owned at-sea product value decreases by 32 percent. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region decrease by 41 percent in total, 39 percent for pollock and 42 percent for cod. These declines are all significant for the sectors involved.

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce Washington Inland Waters participation in the groundfish fishery by 19 to 59 percent for pollock and by 17 to 72 percent for Pacific cod, or about 20 to 54 percent combined. This would have significant effects upon the Alaska groundfish fishing sectors present in the region. Given the scale of the metropolitan Seattle area (where these sectors tend to be based) and the size of the regional economy, however, evaluation of specific community or otherwise geographically localized impacts resulting from these declines is problematic. Taken as a whole, greater Seattle's engagement in, and dependency upon, the North Pacific groundfish fishery is a relatively minor component of the socioeconomic structure of the community, in sharp contrast to some of the smaller Alaskan communities. On the other hand, in absolute terms, the declines accruing to this region are much greater than those for any other region under this alternative.

Alternative 4

The relevant high and low case totals for Alternative 4 (Table 4.12-44) differ by 5 to 6 percent for the measures of interest for pollock and cod (4 to 5 percent for pollock, 7 to 9 percent for Pacific cod). This is somewhat greater than for the baseline (Alternative 1), but is significantly less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. The uncertainty is about the same for both the pollock and Pacific cod fisheries.

Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-46 (recalling that relative dependency on groundfish in general and on Pacific cod and pollock in particular for regional harvesters and processors are as described in the Alternative 2 discussion [i.e., change figures described here are not changes for the total volume and value for either the total combined fisheries or for all groundfish fisheries]). For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels does not decline (0 for pollock, 3 percent for cod). In terms of the value of product processed by regionally owned processors, the total remains unchanged, with a 1 percent decrease for Pacific cod. Regionally owned at-sea product value remains the same, with a 2 percent increase in Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region do not show any decline.

For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 4 percent (4 for pollock, 10 percent for cod). In terms of the value of product processed by regionally owned processors, the difference is 3 percent, 3 percent for pollock and 6 percent for Pacific cod. Regionally owned at-sea product value decreases only by 3 percent. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region decrease by 3 percent in total, 3 percent for pollock and 5 percent for cod.

In summary, the primary effects of Alternative 4 on the Washington Inland Waters region would be upon regional owners of catcher vessels. While processors may be affected in a relatively small degree, such effects may be comparable to those experienced from "normal" fluctuations in the fishery. Catcher vessel owners, on the other hand, may experience a significant decrease in revenue. Those more dependent on Pacific cod would face larger effects, although pollock is the more significant of the two species for fisheries participants from the Washington Inland Waters region. No significant community level impacts are likely. Effects on regional employment, and on the regional tax base, are unlikely to be significant.

4.12.2.2.6 Oregon Coast Region

Alternative 1 - Baseline Conditions

Oregon Coast is perhaps the simplest region to address in terms of the potential effects of the Alternatives, primarily because its articulation to the Alaskan pollock and Pacific cod fisheries is solely through the participation of catcher vessels owned by Oregon Coast residents (Table 4.12-7). Thus, only catcher vessel measures are discussed. For the Oregon Coast region, the difference between the "high" case and the "low" case for Alternative 1 is small (1 to 2 percent). Thus the two are pretty much equivalent. The harvest volume of Pacific cod by catcher vessels owned by Oregon Coast region residents is also relatively small, compared to the harvest of pollock, but Pacific cod makes up close to one-third of combined pollock and Pacific cod value.

Alternative 2

As a measure of uncertainty, the high and low case totals for Alternative 2 (Table 4.12-26) differ by 44 to 46 percent on the measures for catcher vessels owned by residents of the Oregon Coast region (tons of harvest, ex-vessel value, payments to labor, employment). The pollock component differs by 43 to 47 percent, and the Pacific cod component by 40 to 56 percent. Thus, as is the general case, uncertainty of the amount of fish to be harvested and processed is much greater for Alternative 2 than for Alternative 4 (or Alternative 1). For the Oregon Coast region, the uncertainty associated with the Pacific cod fishery under

Alternative 2 may be somewhat higher than that for the pollock fishery, although the pollock fishery is much more significant for the region.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-28. For the high-case of Alternative 2, total combined Atka mackerel, Pacific cod, and pollock harvested by regionally owned catcher vessels declines by about 36 percent (34 for pollock and 49 percent for cod). This reflects the greater importance of pollock over Pacific cod for this region. For the low-case of Alternative 2, total combined groundfish harvested by regionally owned catcher vessels declines by about 64 percent (62 for pollock and 77 for cod). Given that in recent years groundfish has accounted for approximately two-thirds of the ex-vessel value accruing to these vessels overall, and that pollock and Pacific cod accounted for 96 percent of the volume and 93 percent of the value of the groundfish harvest for these vessels in 1999, the declines associated with Alternative 2 are significant for these vessels.

In summary, depending on the specific socioeconomic variable chosen, Alternative 2 is projected to reduce Oregon Coast participation by 34 to 67 percent for pollock and by 44 to 77 percent for Pacific cod, or about 37 to 67 percent for the combined pollock and Pacific cod fisheries in the North Pacific. This would have severe effects upon individual operations, some with connections to operations in other regions. Community level social impacts would be minimal, however, due to the relatively small role of Alaskan groundfish local economies (despite the relative concentration of the fleet in Newport) or the regional economy as a whole. Those operations more dependent on Pacific cod would be more at risk than those depending on pollock, but pollock is by far the more important of the two for most catcher vessels owned by Oregon Coast residents.

Alternative 4

The high and low case totals for Alternative 4 (Table 4.12-47) differ by 6 to 8 percent on the measures for catcher vessels owned by residents of the Oregon Coast region (tons of harvest, ex-vessel value, payments to labor, employment). The pollock component differs by 6 to 7 percent, and the Pacific cod component by 6 to 10 percent. This is somewhat greater than for the baseline (Alternative 1), but is significantly less than for Alternative 2. The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. For the Oregon Coast region for Alternative 4, the uncertainty associated with the Pacific cod and pollock fisheries is about the same, although the pollock fishery is much more significant for the region.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-49 (recalling that relative dependency on groundfish in general and on Pacific cod and pollock in particular for regional harvesters and processors are as described in the Alternative 2 discussion [i.e., the change figures described here are not changes in total volume and value for either the total combined fisheries or for all groundfish fisheries]). For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels does not decline (0 percent for pollock and 2 percent for Pacific cod). For the low-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels declines by about 5 percent (5 for pollock and 7 for cod).

Thus, Alternative 4 is projected to reduce Oregon Coast participation in the harvest component in the groundfish fishery by 9 to 16 percent for pollock and by 10 to 18 percent for Pacific cod, or about 9 to 17 percent in general, depending on the specific variable chosen. This could have significant impacts on individual operations, however, no significant community level impacts are likely to result from this alternative.

Table 4.12-1 Alternative 1 - All regions groundfish fishery socioeconomic indicators

All Regions		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		403	102,908	972,584	1,075,895	341	101,018	963,405	1,064,764
Total Ex-Vessel Value (\$)		30,352	69,434,583	238,300,175	307,765,109	25,678	68,223,562	236,050,176	304,299,416
Total Catcher Vessel Payments to Labor (\$)		12,141	27,773,833	95,320,070	123,106,044	10,271	27,289,425	94,420,070	121,719,766
Total CV Employment (FTE)		0	735	602	1,337	0	726	596	1,323
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		30,978	66,510,998	175,769,565	242,311,540	26,284	65,366,686	174,573,492	239,966,461
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		67,477	133,866	778,876	980,219	50,862	131,489	767,341	949,692
Total Shore Based Processing in the Region (Round-Weight Tons)		412	98,185	717,245	815,842	349	96,400	712,371	809,120
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		67,876	226,983	1,517,216	1,812,075	51,194	222,867	1,500,692	1,774,753
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		28,445,925	148,658,977	603,383,713	780,488,616	21,442,403	146,020,803	594,429,714	761,892,920
Total Shore Based Processed Value in the Region (\$)		114,955	138,778,804	474,135,587	613,029,347	88,268	136,323,058	470,901,591	607,312,917
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		28,568,826	279,215,304	1,093,851,687	1,401,635,816	21,536,743	274,204,860	1,081,566,595	1,377,308,198
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		8,518,157	43,526,692	156,973,556	209,018,404	6,420,969	42,753,916	154,645,322	203,820,206
Total Shore Based Processing Payments to Labor in the Region (\$)		34,487	41,633,641	142,240,676	183,908,804	26,480	40,896,917	141,270,477	182,193,875
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		2,856,883	27,921,530	109,385,169	140,163,582	2,153,674	27,420,486	108,156,660	137,730,820
Total Processing Payments to Labor Accruing to the Region (\$)		11,409,526	113,081,864	408,599,401	533,090,790	8,601,123	111,071,319	404,072,458	523,744,901
Total Regionally Owned At-Sea Processing Employment (FTE)		254	923	2,815	3,992	192	902	2,773	3,867
Total Shore Based Processing Employment in the Region (FTE)		1	940	3,262	4,203	1	923	3,240	4,163
Total Administrative Employment of All Regionally Owned Processors (FTE)		13	90	309	412	10	88	306	404
Total Processing Employment Accruing to the Region (FTE)		268	1,953	6,386	8,606	202	1,913	6,319	8,434
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		11,421,666	140,855,697	503,919,471	656,196,834	8,611,394	138,360,744	498,492,529	645,464,667
Total Harvesting and Processing Employment Accruing to the Region (FTE)		268	2,688	6,987	9,943	202	2,639	6,915	9,756

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-2 Alternative 1 - Alaska Peninsula/Aleutian Island region groundfish fishery socioeconomic indicators

01-Alaska Peninsula/ Aleutian Islands Region	High						Low			
Annual Summary Table	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total		
Total Regionally Owned CV Harvest (Tons)	33	7,560	10,249	17,842	33	7,402	10,130	17,565		
Total Ex-Vessel Value (\$)	2,453	5,126,233	2,546,182	7,674,867	2,453	5,021,799	2,516,492	7,540,744		
Total Catcher Vessel Payments to Labor (\$)	981	2,050,493	1,018,473	3,069,947	981	2,008,720	1,006,597	3,016,297		
Total CV Employment (FTE)	0	62	24	86	0	61	24	85		
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	30,978	43,651,417	161,717,601	205,399,996	26,284	42,641,047	160,576,571	203,243,901		
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	0	96	10	106	0	95	10	105		
Total Shore Based Processing in the Region (Round-Weight Tons)	412	68,358	659,706	728,475	349	66,762	655,057	722,169		
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	1	234	416	651	1	230	412	643		
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	0	111,448	6,449	117,896	0	110,723	6,357	117,079		
Total Shore Based Processed Value in the Region (\$)	114,955	93,088,126	441,921,195	535,124,276	88,268	90,908,658	438,808,190	529,805,116		
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	4	314,917	249,174	564,094	4	309,535	246,619	556,158		
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	0	32,194	1,755	33,949	0	32,001	1,730	33,731		
Total Shore Based Processing Payments to Labor in the Region (\$)	34,487	27,926,438	132,576,358	160,537,283	26,480	27,272,597	131,642,457	158,941,535		
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	0	31,492	24,917	56,409	0	30,954	24,662	55,616		
Total Processing Payments to Labor Accruing to the Region (\$)	34,487	27,990,124	132,603,030	160,627,641	26,481	27,335,552	131,668,849	159,030,882		
Total Regionally Owned At-Sea Processing Employment (FTE)	0	1	0	1	0	1	0	1		
Total Shore Based Processing Employment in the Region (FTE)	1	656	3,035	3,692	1	640	3,014	3,655		
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	0	0	0	0	0	0	0		
Total Processing Employment Accruing to the Region (FTE)	1	657	3,036	3,693	1	641	3,014	3,656		
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	35,468	30,040,617	133,621,503	163,697,588	27,462	29,344,272	132,675,445	162,047,179		
Total Harvesting and Processing Employment Accruing to the Region (FTE)	1	718	3,060	3,779	1	702	3,038	3,741		

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-3 Alternative 1 - Kodiak region groundfish fishery socioeconomic indicators

02-Alaska Kodiak Region	High				Low			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Annual Summary Table								
Total Regionally Owned CV Harvest (Tons)	32	19,768	41,971	61,771	32	19,482	41,637	61,150
Total Ex-Vessel Value (\$)	2,383	13,576,732	10,291,216	23,870,331	2,381	13,390,427	10,209,082	23,601,889
Total Catcher Vessel Payments to Labor (\$)	953	5,430,693	4,116,486	9,548,132	952	5,356,171	4,083,633	9,440,756
Total CV Employment (FTE)	0	175	52	227	0	173	51	225
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	17,900,348	13,459,654	31,360,002	0	17,776,920	13,405,450	31,182,370
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	1,552	3,800	999	6,351	1,170	3,759	985	5,914
Total Shore Based Processing in the Region (Round-Weight Tons)	0	23,850	55,113	78,963	0	23,672	54,892	78,564
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	1,552	8,545	11,957	22,054	1,170	8,468	11,899	21,538
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	654,421	4,280,441	775,551	5,710,414	493,311	4,230,958	764,834	5,489,103
Total Shore Based Processed Value in the Region (\$)	0	35,780,339	30,065,522	65,845,861	0	35,523,457	29,946,375	65,469,831
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	654,421	11,399,113	6,753,517	18,807,051	493,311	11,298,553	6,719,109	18,510,973
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	196,326	1,234,687	232,607	1,663,621	147,993	1,220,273	229,393	1,597,659
Total Shore Based Processing Payments to Labor in the Region (\$)	0	10,734,102	9,019,657	19,753,758	0	10,657,037	8,983,912	19,640,949
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	65,442	1,139,911	675,352	1,880,705	49,331	1,129,855	671,911	1,851,097
Total Processing Payments to Labor Accruing to the Region (\$)	261,768	13,108,700	9,927,616	23,298,084	197,324	13,007,165	9,885,216	23,089,706
Total Regionally Owned At-Sea Processing Employment (FTE)	6	25	7	38	4	25	6	36
Total Shore Based Processing Employment in the Region (FTE)	0	261	219	479	0	259	218	477
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	4	3	7	0	4	2	7
Total Processing Employment Accruing to the Region (FTE)	6	290	228	524	5	287	227	519
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	262,722	18,539,393	14,044,102	32,846,217	198,277	18,363,336	13,968,849	32,530,461
Total Harvesting and Processing Employment Accruing to the Region (FTE)	6	465	280	751	5	460	278	744

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-4 Alternative 1 - Southcentral region groundfish fishery socioeconomic indicators

03-Alaska Southcentral Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		20	5,868	2,888	8,775	20	5,813	2,866	8,700
Total Ex-Vessel Value (\$)		1,511	4,329,899	708,301	5,039,712	1,511	4,292,957	703,096	4,997,565
Total Catcher Vessel Payments to Labor (\$)		605	1,731,960	283,321	2,015,885	604	1,717,183	281,238	1,999,026
Total CV Employment (FTE)		0	80	4	85	0	80	4	84
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	2,712,065	592,093	3,304,159	0	2,701,589	591,254	3,292,843
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	6,949	322	7,270	0	6,930	317	7,247
Total Shore Based Processing in the Region (Round-Weight Tons)		0	3,274	2,424	5,699	0	3,262	2,421	5,683
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		15	12,152	11,412	23,579	15	12,069	11,327	23,411
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	7,663,846	252,059	7,915,905	0	7,642,923	248,455	7,891,378
Total Shore Based Processed Value in the Region (\$)		0	5,231,496	2,147,902	7,379,398	0	5,212,173	2,146,058	7,358,231
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		56	15,556,161	6,970,761	22,526,979	53	15,439,341	6,921,286	22,360,680
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,299,154	75,618	2,374,771	0	2,292,877	74,536	2,367,413
Total Shore Based Processing Payments to Labor in the Region (\$)		0	1,569,449	644,371	2,213,819	0	1,563,652	643,817	2,207,469
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		6	1,555,616	697,076	2,252,698	5	1,543,934	692,129	2,236,068
Total Processing Payments to Labor Accruing to the Region (\$)		6	5,424,219	1,417,064	6,841,289	5	5,400,463	1,410,482	6,810,951
Total Regionally Owned At-Sea Processing Employment (FTE)		0	42	1	43	0	42	1	43
Total Shore Based Processing Employment in the Region (FTE)		0	18	7	26	0	18	7	26
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	5	2	7	0	5	2	7
Total Processing Employment Accruing to the Region (FTE)		0	65	11	76	0	65	11	76
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		610	7,156,178	1,700,385	8,857,173	610	7,117,646	1,691,721	8,809,976
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	145	15	161	0	144	15	160

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-5 Alternative 1 - Southeast region groundfish fishery socioeconomic indicators

04-Alaska Southeast Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		24	6,477	843	7,343	24	6,428	832	7,284
Total Ex-Vessel Value (\$)		1,800	5,100,274	210,058	5,312,132	1,800	5,066,264	207,308	5,275,372
Total Catcher Vessel Payments to Labor (\$)		720	2,040,110	84,023	2,124,853	720	2,026,506	82,923	2,110,149
Total CV Employment (FTE)		0	102	2	104	0	101	2	103
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	2,247,168	216	2,247,384	0	2,247,131	216	2,247,347
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	7,708	357	8,064	0	7,687	352	8,039
Total Shore Based Processing in the Region (Round-Weight Tons)		0	2,684	1	2,685	0	2,684	1	2,685
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	8,612	357	8,969	0	8,591	352	8,943
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	8,500,869	279,588	8,780,457	0	8,477,660	275,590	8,753,251
Total Shore Based Processed Value in the Region (\$)		0	4,646,455	938	4,647,394	0	4,646,389	938	4,647,328
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	10,065,806	279,904	10,345,710	0	10,042,575	275,906	10,318,482
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,550,261	83,876	2,634,137	0	2,543,298	82,677	2,625,975
Total Shore Based Processing Payments to Labor in the Region (\$)		0	1,393,937	282	1,394,218	0	1,393,917	282	1,394,198
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	1,006,581	27,990	1,034,571	0	1,004,258	27,591	1,031,848
Total Processing Payments to Labor Accruing to the Region (\$)		0	4,950,778	112,148	5,062,926	0	4,941,473	110,549	5,052,022
Total Regionally Owned At-Sea Processing Employment (FTE)		0	47	2	48	0	46	2	48
Total Shore Based Processing Employment in the Region (FTE)		0	6	0	6	0	6	0	6
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	2	0	3	0	2	0	2
Total Processing Employment Accruing to the Region (FTE)		0	55	2	56	0	55	2	56
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		720	6,990,887	196,171	7,187,779	720	6,967,978	193,472	7,162,171
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	156	4	160	0	156	4	159

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-6 Alternative 1 - Washington inland waters region groundfish fishery socioeconomic indicators

05-Washington Inland Waters Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		277	41,938	788,477	830,691	217	41,010	780,898	822,125
Total Ex-Vessel Value (\$)		20,831	27,475,092	193,150,656	220,646,579	16,319	26,888,352	191,293,512	218,198,184
Total Catcher Vessel Payments to Labor (\$)		8,332	10,990,037	77,260,262	88,258,631	6,528	10,755,341	76,517,405	87,279,273
Total CV Employment (FTE)		0	214	411	625	0	211	407	618
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		58,551	111,217	772,896	942,664	44,133	109,077	761,444	914,655
Total Shore Based Processing in the Region (Round-Weight Tons)		0	19	0	19	0	19	0	19
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		58,934	193,344	1,488,781	1,741,059	44,449	189,569	1,472,468	1,706,486
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		24,682,802	123,285,098	598,774,599	746,742,500	18,605,713	120,933,384	589,884,361	729,423,458
Total Shore Based Processed Value in the Region (\$)		0	32,388	30	32,419	0	32,381	30	32,411
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		24,805,643	237,062,031	1,076,302,863	1,338,170,537	18,699,996	232,489,699	1,064,153,558	1,315,343,253
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		7,389,220	36,053,249	155,595,383	199,037,851	5,569,962	35,364,868	153,286,212	194,221,041
Total Shore Based Processing Payments to Labor in the Region (\$)		0	9,716	9	9,726	0	9,714	9	9,723
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		2,480,564	23,706,203	107,630,286	133,817,054	1,870,000	23,248,970	106,415,356	131,534,325
Total Processing Payments to Labor Accruing to the Region (\$)		9,869,784	59,769,168	263,225,678	332,864,630	7,439,961	58,623,552	259,701,577	325,765,090
Total Regionally Owned At-Sea Processing Employment (FTE)		220	766	2,775	3,761	166	748	2,734	3,648
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		11	77	302	391	8	75	299	383
Total Processing Employment Accruing to the Region (FTE)		231	843	3,077	4,152	174	824	3,033	4,031
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		9,878,116	70,759,205	340,485,940	421,123,262	7,446,489	69,378,893	336,218,982	413,044,363
Total Harvesting and Processing Employment Accruing to the Region (FTE)		231	1,057	3,488	4,777	174	1,034	3,440	4,649

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives and therefore do not change the relative impacts or ranking of the alternatives.

Table 4.12-7 Alternative 1 - Oregon Coast region groundfish fishery socioeconomic indicators

06-Oregon Coast Region	High					Low				
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	Atka	Total
Annual Summary Table										
Total Regionally Owned CV Harvest (Tons)	1	14,067	79,062	93,130	1	13,781	78,384	92,166		
Total Ex-Vessel Value (\$)	65	8,984,191	19,368,019	28,352,274	59	8,804,181	19,201,885	28,006,124		
Total Catcher Vessel Payments to Labor (\$)	26	3,593,676	7,747,208	11,340,910	24	3,521,672	7,680,754	11,202,450		
Total CV Employment (FTE)	0	54	71	125	0	53	70	123		
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	0	0	0	0	0	0	0		
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	0	0	0	0	0	0	0	0		
Total Shore Based Processing in the Region (Round-Weight Tons)	0	0	0	0	0	0	0	0		
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	0	0	0	0	0	0	0	0		
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	0	0	0	0	0	0	0	0		
Total Shore Based Processed Value in the Region (\$)	0	0	0	0	0	0	0	0		
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	0	0	0	0	0	0	0	0		
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	0	0	0	0	0	0	0	0		
Total Shore Based Processing Payments to Labor in the Region (\$)	0	0	0	0	0	0	0	0		
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	0	0	0	0	0	0	0	0		
Total Processing Payments to Labor Accruing to the Region (\$)	0	0	0	0	0	0	0	0		
Total Regionally Owned At-Sea Processing Employment (FTE)	0	0	0	0	0	0	0	0		
Total Shore Based Processing Employment in the Region (FTE)	0	0	0	0	0	0	0	0		
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	0	0	0	0	0	0	0		
Total Processing Employment Accruing to the Region (FTE)	0	0	0	0	0	0	0	0		
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	26	3,593,676	7,747,208	11,340,910	24	3,521,672	7,680,754	11,202,450		
Total Harvesting and Processing Employment Accruing to the Region (FTE)	0	54	71	125	0	53	70	123		

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-8 Alternative 2 - All regions groundfish fishery socioeconomic indicators

All Regions		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		134	55,258	692,116	747,507	83	34,131	443,141	477,356
Total Ex-Vessel Value (\$)		10,052	37,537,593	169,544,239	207,091,884	6,277	24,063,245	108,531,187	132,600,709
Total Catcher Vessel Payments to Labor (\$)		4,021	15,015,037	67,817,696	82,836,754	2,511	9,625,298	43,412,475	53,040,284
Total CV Employment (FTE)		0	456	404	860	0	371	240	611
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		10,261	35,576,617	119,287,636	154,874,514	6,469	22,892,983	69,719,263	92,618,715
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		22,266	108,509	632,024	762,799	9,544	90,473	531,819	631,836
Total Shore Based Processing in the Region (Round-Weight Tons)		136	52,146	486,891	539,174	86	32,276	284,647	317,010
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		22,398	157,257	1,138,297	1,317,953	9,622	119,557	831,642	960,821
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		9,386,542	124,842,339	489,689,012	623,917,892	4,023,560	103,907,720	411,084,888	519,016,167
Total Shore Based Processed Value in the Region (\$)		37,946	74,513,451	324,851,587	399,402,985	16,384	47,158,170	192,637,768	239,812,323
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		9,427,110	193,994,684	828,606,962	1,032,028,756	4,041,053	146,194,969	614,165,331	764,401,352
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		2,810,808	36,458,376	127,396,990	166,666,175	1,204,859	30,238,569	106,930,276	138,373,704
Total Shore Based Processing Payments to Labor in the Region (\$)		11,384	22,354,035	97,455,476	119,820,895	4,915	14,147,451	57,791,330	71,943,697
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		942,711	19,399,468	82,860,696	103,202,876	404,105	14,619,497	61,416,533	76,440,135
Total Processing Payments to Labor Accruing to the Region (\$)		3,764,903	78,211,880	307,713,162	389,689,946	1,613,880	59,005,517	226,138,139	286,757,537
Total Regionally Owned At-Sea Processing Employment (FTE)		84	767	2,281	3,133	36	626	1,917	2,579
Total Shore Based Processing Employment in the Region (FTE)		0	502	2,230	2,732	0	313	1,317	1,630
Total Administrative Employment of All Regionally Owned Processors (FTE)		4	62	230	296	2	45	165	212
Total Processing Employment Accruing to the Region (FTE)		88	1,331	4,742	6,161	38	984	3,399	4,422
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		3,768,924	93,226,917	375,530,858	472,526,699	1,616,391	68,630,815	269,550,614	339,797,820
Total Harvesting and Processing Employment Accruing to the Region (FTE)		88	1,787	5,145	7,021	38	1,355	3,639	5,032

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-9 Alternative 2 - All regions groundfish fishery socioeconomic indicators difference from Alternative 1 (Baseline)

All Regions	High Difference from Alternative 1 (Baseline)			Low Difference from Alternative 1 (Baseline)			Total
	Atka	Pacific cod	Pollock	Atka	Pacific cod	Pollock	Total
Annual Summary Table							
Total Regionally Owned CV Harvest (Tons)	-270	-47,650	-280,468	-258	-66,887	-520,264	-587,409
Total Ex-Vessel Value (\$)	-20,299	-31,896,990	-68,755,936	-19,401	-44,160,318	-127,518,988	-171,698,707
Total Catcher Vessel Payments to Labor (\$)	-8,120	-12,758,796	-27,502,374	-7,760	-17,664,127	-51,007,595	-68,679,483
Total CV Employment (FTE)	0	-278	-198	0	-355	-357	-712
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	-20,717	-30,934,381	-56,481,928	-19,814	-42,473,703	-104,854,229	-147,347,747
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	-45,211	-25,357	-146,852	-41,318	-41,015	-235,523	-317,856
Total Shore Based Processing in the Region (Round-Weight Tons)	-275	-46,039	-230,354	-263	-64,123	-427,723	-492,110
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	-45,478	-69,726	-378,919	-41,571	-103,311	-669,050	-813,932
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	-19,059,384	-23,816,638	-113,694,701	-17,418,843	-42,113,084	-183,344,826	-242,876,753
Total Shore Based Processed Value in the Region (\$)	-77,009	-64,265,353	-149,284,000	-71,883	-89,164,887	-278,263,823	-367,500,594
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	-19,141,715	-85,220,620	-265,244,725	-17,495,690	-128,009,891	-467,401,264	-612,906,845
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	-5,707,349	-7,068,315	-29,576,566	-5,216,110	-12,515,347	-47,715,046	-65,446,502
Total Shore Based Processing Payments to Labor in the Region (\$)	-23,103	-19,279,606	-44,785,200	-21,565	-26,749,466	-83,479,147	-110,250,178
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	-1,914,172	-8,522,062	-26,524,472	-1,749,569	-12,800,989	-46,740,126	-61,290,685
Total Processing Payments to Labor Accruing to the Region (\$)	-7,644,623	-34,869,983	-100,886,238	-6,987,244	-52,065,802	-177,934,319	-236,987,364
Total Regionally Owned At-Sea Processing Employment (FTE)	-170	-155	-533	-156	-276	-856	-1,288
Total Shore Based Processing Employment in the Region (FTE)	-1	-438	-1,032	0	-610	-1,923	-2,533
Total Administrative Employment of All Regionally Owned Processors (FTE)	-9	-29	-79	-8	-43	-141	-192
Total Processing Employment Accruing to the Region (FTE)	-179	-622	-1,644	-164	-929	-2,919	-4,012
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	-7,652,742	-47,628,779	-128,388,613	-6,995,004	-69,729,929	-228,941,914	-305,666,847
Total Harvesting and Processing Employment Accruing to the Region (FTE)	-180	-900	-1,842	-164	-1,284	-3,276	-4,724

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-10 Alternative 2 - All regions groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

All Regions		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-46%	-29%	-31%	-76%	-66%	-54%	-55%
Total Ex-Vessel Value (\$)		-67%	-46%	-29%	-33%	-76%	-65%	-54%	-56%
Total Catcher Vessel Payments to Labor (\$)		-67%	-46%	-29%	-33%	-76%	-65%	-54%	-56%
Total CV Employment (FTE)		-67%	-38%	-33%	-36%	-67%	-49%	-60%	-54%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		-67%	-47%	-32%	-36%	-75%	-65%	-60%	-61%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		-67%	-19%	-19%	-22%	-81%	-31%	-31%	-33%
Total Shore Based Processing in the Region (Round-Weight Tons)		-67%	-47%	-32%	-34%	-75%	-67%	-60%	-61%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-31%	-25%	-27%	-81%	-46%	-45%	-46%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		-67%	-16%	-19%	-20%	-81%	-29%	-31%	-32%
Total Shore Based Processed Value in the Region (\$)		-67%	-46%	-31%	-35%	-81%	-65%	-59%	-61%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-31%	-24%	-26%	-81%	-47%	-43%	-45%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		-67%	-16%	-19%	-20%	-81%	-29%	-31%	-32%
Total Shore Based Processing Payments to Labor in the Region (\$)		-67%	-46%	-31%	-35%	-81%	-65%	-59%	-61%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-31%	-24%	-26%	-81%	-47%	-43%	-45%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-31%	-25%	-27%	-81%	-47%	-44%	-45%
Total Regionally Owned At-Sea Processing Employment (FTE)		-67%	-17%	-19%	-22%	-81%	-31%	-31%	-33%
Total Shore Based Processing Employment in the Region (FTE)		-67%	-47%	-32%	-35%	-81%	-66%	-59%	-61%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-32%	-26%	-28%	-81%	-49%	-46%	-47%
Total Processing Employment Accruing to the Region (FTE)		-67%	-32%	-26%	-28%	-81%	-49%	-46%	-48%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-34%	-25%	-28%	-81%	-50%	-46%	-47%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-33%	-26%	-29%	-81%	-49%	-47%	-48%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-11 Alternative 2 - Alaska Peninsula/Aleutian Islands region groundfish fishery socioeconomic indicators

01-Alaska Peninsula/ Aleutian Islands Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		11	3,433	4,591	8,035	11	2,230	1,002	3,243
Total Ex-Vessel Value (\$)		818	2,338,070	1,140,381	3,479,268	818	1,543,959	249,376	1,794,153
Total Catcher Vessel Payments to Labor (\$)		327	935,228	456,152	1,391,707	327	617,584	99,750	717,661
Total CV Employment (FTE)		0	32	11	43	0	24	2	26
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		10,261	22,738,765	112,991,003	135,740,029	6,469	11,952,640	68,626,790	80,585,899
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	80	6	86	0	68	3	71
Total Shore Based Processing in the Region (Round-Weight Tons)		136	35,311	461,108	496,555	86	18,133	280,174	298,392
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	166	229	395	0	129	97	226
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	96,152	3,983	100,135	0	80,526	2,428	82,955
Total Shore Based Processed Value in the Region (\$)		37,946	48,581,495	310,423,417	359,042,859	16,384	25,221,816	189,698,296	214,936,497
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		1	221,882	140,369	362,252	1	168,871	62,544	231,416
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	27,853	1,111	28,965	0	23,405	705	24,111
Total Shore Based Processing Payments to Labor in the Region (\$)		11,384	14,574,449	93,127,025	107,712,858	4,915	7,566,545	56,909,489	64,480,949
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	22,188	14,037	36,225	0	16,887	6,254	23,142
Total Processing Payments to Labor Accruing to the Region (\$)		11,384	14,624,490	93,142,174	107,778,048	4,915	7,606,837	56,916,448	64,528,201
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	1	0	1
Total Shore Based Processing Employment in the Region (FTE)		0	344	2,129	2,473	0	181	1,298	1,480
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	345	2,129	2,474	0	182	1,298	1,480
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		11,711	15,559,718	93,598,326	109,169,755	5,242	8,224,421	57,016,199	65,245,862
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	378	2,140	2,517	0	205	1,301	1,506

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-12 Alternative 2 - Alaska Peninsula/Aleutian Islands region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

01-Alaska Peninsula/ Aleutian Islands Region	High Difference from Alternative 1 (Baseline)					Low Difference from Alternative 1 (Baseline)				
	Annual Summary Table	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	
Total Regionally Owned CV Harvest (Tons)		-22	-4,127	-5,659	-9,807	-22	-5,172	-9,129	-14,322	
Total Ex-Vessel Value (\$)		-1,635	-2,788,163	-1,405,801	-4,195,599	-1,635	-3,477,840	-2,267,116	-5,746,591	
Total Catcher Vessel Payments to Labor (\$)		-654	-1,115,265	-562,320	-1,678,240	-654	-1,391,136	-906,846	-2,298,636	
Total CV Employment (FTE)		0	-29	-13	-43	0	-37	-22	-59	
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		-20,717	-20,912,652	-48,726,598	-69,659,967	-19,814	-30,688,407	-91,949,781	-122,658,003	
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	-16	-4	-20	0	-28	-7	-34	
Total Shore Based Processing in the Region (Round-Weight Tons)		-275	-33,047	-198,598	-231,921	-263	-48,630	-374,883	-423,776	
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-1	-68	-188	-256	-1	-101	-315	-417	
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	-15,296	-2,465	-17,761	0	-30,196	-3,928	-34,125	
Total Shore Based Processed Value in the Region (\$)		-77,009	-44,506,631	-131,497,777	-176,081,417	-71,883	-65,686,842	-249,109,894	-314,868,619	
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-3	-93,034	-108,805	-201,842	-3	-140,664	-184,075	-324,742	
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	-4,341	-643	-4,984	0	-8,596	-1,024	-9,620	
Total Shore Based Processing Payments to Labor in the Region (\$)		-23,103	-13,351,989	-39,449,333	-52,824,425	-21,565	-19,706,053	-74,732,968	-94,460,586	
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-9,303	-10,881	-20,184	0	-14,066	-18,408	-32,474	
Total Processing Payments to Labor Accruing to the Region (\$)		-23,103	-13,365,634	-39,460,857	-62,849,593	-21,565	-19,728,715	-74,752,400	-94,502,680	
Total Regionally Owned At-Sea Processing Employment (FTE)		0	0	0	0	0	0	0	0	
Total Shore Based Processing Employment in the Region (FTE)		-1	-311	-907	-1,219	0	-459	-1,716	-2,175	
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0	
Total Processing Employment Accruing to the Region (FTE)		-1	-312	-907	-1,219	0	-459	-1,716	-2,176	
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-23,757	-14,480,899	-40,023,177	-54,527,833	-22,219	-21,119,851	-75,659,246	-96,801,317	
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-1	-341	-920	-1,262	-1	-496	-1,737	-2,235	

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-13 Alternative 2 - Alaska Peninsula/Aleutian Islands region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

01-Alaska Peninsula/ Aleutian Islands Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-55%	-55%	-55%	-67%	-70%	-90%	-82%
Total Ex-Vessel Value (\$)		-67%	-54%	-55%	-55%	-67%	-69%	-90%	-76%
Total Catcher Vessel Payments to Labor (\$)		-67%	-54%	-55%	-55%	-67%	-69%	-90%	-76%
Total CV Employment (FTE)		-67%	-47%	-55%	-50%	-67%	-61%	-90%	-69%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		-67%	-48%	-30%	-34%	-75%	-72%	-57%	-60%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		-67%	-16%	-41%	-19%	-81%	-29%	-67%	-33%
Total Shore Based Processing in the Region (Round-Weight Tons)		-67%	-48%	-30%	-32%	-75%	-73%	-57%	-59%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-29%	-45%	-39%	-67%	-44%	-76%	-65%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		-67%	-14%	-38%	-15%	-81%	-27%	-62%	-29%
Total Shore Based Processed Value in the Region (\$)		-67%	-48%	-30%	-33%	-81%	-72%	-57%	-59%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-30%	-44%	-36%	-69%	-45%	-75%	-58%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		-67%	-13%	-37%	-15%	-81%	-27%	-59%	-29%
Total Shore Based Processing Payments to Labor in the Region (\$)		-67%	-48%	-30%	-33%	-81%	-72%	-57%	-59%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-30%	-44%	-36%	-69%	-45%	-75%	-58%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-48%	-30%	-33%	-81%	-72%	-57%	-59%
Total Regionally Owned At-Sea Processing Employment (FTE)		-67%	-16%	-48%	-19%	-81%	-31%	-77%	-35%
Total Shore Based Processing Employment in the Region (FTE)		-67%	-47%	-30%	-33%	-81%	-72%	-57%	-60%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-30%	-44%	-36%	-70%	-46%	-75%	-59%
Total Processing Employment Accruing to the Region (FTE)		-67%	-47%	-30%	-33%	-81%	-72%	-57%	-60%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-48%	-30%	-33%	-81%	-72%	-57%	-60%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-47%	-30%	-33%	-80%	-71%	-57%	-60%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-14 Alternative 2 - Kodiak region groundfish fishery socioeconomic indicators

02-Alaska Kodiak Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		11	11,537	24,865	36,412	11	8,293	11,951	20,255
Total Ex-Vessel Value (\$)		794	7,940,808	6,094,830	14,036,432	792	5,845,822	2,928,389	8,775,004
Total Catcher Vessel Payments to Labor (\$)		318	3,176,323	2,437,932	5,614,573	317	2,338,329	1,171,356	3,510,001
Total CV Employment (FTE)		0	114	28	143	0	96	11	107
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	9,734,653	6,033,211	15,767,863	0	8,146,865	922,470	9,069,335
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		512	3,241	811	4,564	220	2,769	702	3,691
Total Shore Based Processing in the Region (Round-Weight Tons)		0	12,994	24,704	37,698	0	10,697	3,777	14,475
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		512	5,826	5,723	12,061	220	4,898	1,453	6,571
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		215,945	3,757,386	629,635	4,602,965	92,565	3,210,259	544,971	3,847,795
Total Shore Based Processed Value in the Region (\$)		0	19,532,497	13,474,098	33,006,595	0	16,190,998	2,222,250	18,413,247
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		215,945	7,643,778	3,308,707	11,168,430	92,565	6,432,010	986,825	7,511,400
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		64,783	1,077,048	188,843	1,330,675	27,770	913,376	163,450	1,104,596
Total Shore Based Processing Payments to Labor in the Region (\$)		0	5,859,749	4,042,229	9,901,979	0	4,857,299	666,675	5,523,974
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		21,594	764,378	330,871	1,116,843	9,257	643,201	98,682	751,140
Total Processing Payments to Labor Accruing to the Region (\$)		86,378	7,701,175	4,561,944	12,349,497	37,026	6,413,876	928,808	7,379,710
Total Regionally Owned At-Sea Processing Employment (FTE)		2	22	5	29	1	19	5	24
Total Shore Based Processing Employment in the Region (FTE)		0	142	98	240	0	118	16	134
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	3	1	4	0	2	0	3
Total Processing Employment Accruing to the Region (FTE)		2	167	105	273	1	139	21	161
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		86,696	10,877,499	6,999,876	17,964,070	37,343	8,752,205	2,100,163	10,889,712
Total Harvesting and Processing Employment Accruing to the Region (FTE)		2	281	133	416	1	234	32	268

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-16 Alternative 2 - Kodiak region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

02-Alaska Kodiak Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-42%	-41%	-41%	-67%	-57%	-71%	-67%
Total Ex-Vessel Value (\$)		-67%	-42%	-41%	-41%	-67%	-56%	-71%	-63%
Total Catcher Vessel Payments to Labor (\$)		-67%	-42%	-41%	-41%	-67%	-56%	-71%	-63%
Total CV Employment (FTE)		-67%	-35%	-46%	-37%	-67%	-45%	-78%	-52%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	-46%	-55%	-50%	0%	-54%	-93%	-71%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		-67%	-15%	-19%	-28%	-81%	-26%	-29%	-38%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-46%	-55%	-52%	0%	-55%	-93%	-82%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-32%	-52%	-45%	-81%	-42%	-88%	-69%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		-67%	-12%	-19%	-19%	-81%	-24%	-29%	-30%
Total Shore Based Processed Value in the Region (\$)		0%	-45%	-55%	-50%	0%	-54%	-93%	-72%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-33%	-51%	-41%	-81%	-43%	-85%	-59%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		-67%	-13%	-19%	-20%	-81%	-25%	-29%	-31%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-45%	-55%	-50%	0%	-54%	-93%	-72%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-33%	-51%	-41%	-81%	-43%	-85%	-59%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-41%	-54%	-47%	-81%	-51%	-91%	-68%
Total Regionally Owned At-Sea Processing Employment (FTE)		-67%	-13%	-19%	-22%	-81%	-25%	-29%	-33%
Total Shore Based Processing Employment in the Region (FTE)		0%	-45%	-55%	-50%	0%	-54%	-93%	-72%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-35%	-50%	-42%	-81%	-45%	-84%	-61%
Total Processing Employment Accruing to the Region (FTE)		-67%	-42%	-54%	-48%	-81%	-52%	-91%	-69%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-41%	-50%	-45%	-81%	-52%	-85%	-67%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-40%	-53%	-45%	-81%	-49%	-88%	-64%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-17 Alternative 2 - Southcentral region groundfish fishery socioeconomic indicators

03-Alaska Southcentral Region	High				Low			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Annual Summary Table								
Total Regionally Owned CV Harvest (Tons)	7	3,841	1,554	5,401	7	3,312	598	3,917
Total Ex-Vessel Value (\$)	504	2,776,962	381,065	3,158,530	504	2,416,192	146,715	2,563,410
Total Catcher Vessel Payments to Labor (\$)	202	1,110,785	152,426	1,263,412	201	966,477	58,686	1,025,364
Total CV Employment (FTE)	0	57	2	59	0	50	1	51
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	1,706,418	263,327	1,969,744	0	1,524,865	169,917	1,694,782
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	0	5,927	261	6,188	0	5,090	222	5,312
Total Shore Based Processing in the Region (Round-Weight Tons)	0	2,161	1,078	3,239	0	1,920	696	2,616
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	5	9,079	5,829	14,913	5	7,607	2,179	9,790
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	0	6,749,171	204,635	6,953,806	0	5,791,210	173,613	5,964,823
Total Shore Based Processed Value in the Region (\$)	0	3,494,057	953,643	4,447,700	0	3,103,951	716,833	3,820,784
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	19	11,549,240	3,618,752	15,168,010	16	9,625,734	1,532,920	11,158,670
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	0	2,024,751	61,391	2,086,142	0	1,737,363	52,084	1,789,447
Total Shore Based Processing Payments to Labor in the Region (\$)	0	1,048,217	286,093	1,334,310	0	931,185	215,050	1,146,235
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	2	1,154,924	361,875	1,516,801	2	962,573	153,292	1,115,867
Total Processing Payments to Labor Accruing to the Region (\$)	2	4,227,892	709,359	4,937,253	2	3,631,122	420,426	4,051,549
Total Regionally Owned At-Sea Processing Employment (FTE)	0	37	1	38	0	32	1	33
Total Shore Based Processing Employment in the Region (FTE)	0	12	3	15	0	11	2	13
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	3	1	5	0	3	0	3
Total Processing Employment Accruing to the Region (FTE)	0	52	6	58	0	45	4	49
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	203	5,338,677	861,784	6,200,665	203	4,597,598	479,112	5,076,913
Total Harvesting and Processing Employment Accruing to the Region (FTE)	0	109	8	117	0	96	5	100

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-18 Alternative 2 - Southcentral region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

03-Alaska Southcentral Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-13	-2,027	-1,334	-3,374	-13	-2,501	-2,268	-4,783
Total Ex-Vessel Value (\$)		-1,008	-1,552,937	-327,237	-1,881,181	-1,008	-1,876,765	-556,381	-2,434,154
Total Catcher Vessel Payments to Labor (\$)		-403	-621,175	-130,895	-752,472	-403	-750,706	-222,553	-973,662
Total CV Employment (FTE)		0	-24	-2	-26	0	-30	-3	-33
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-1,005,648	-328,767	-1,334,414	0	-1,176,724	-421,337	-1,598,061
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	-1,022	-61	-1,082	0	-1,840	-95	-1,935
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-1,113	-1,346	-2,460	0	-1,341	-1,725	-3,067
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-10	-3,073	-5,583	-8,666	-10	-4,462	-9,149	-13,620
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	-914,675	-47,424	-962,099	0	-1,851,713	-74,842	-1,926,555
Total Shore Based Processed Value in the Region (\$)		0	-1,737,439	-1,194,259	-2,931,698	0	-2,108,222	-1,429,225	-3,537,447
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-37	-4,006,922	-3,352,009	-7,358,969	-37	-5,813,607	-5,388,367	-11,202,010
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	-274,403	-14,227	-288,630	0	-555,514	-22,453	-577,966
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-521,232	-358,278	-879,509	0	-632,467	-428,768	-1,061,234
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-4	-400,692	-335,201	-735,897	-4	-581,361	-538,837	-1,120,201
Total Processing Payments to Labor Accruing to the Region (\$)		-4	-1,196,326	-707,706	-1,904,036	-4	-1,769,341	-990,057	-2,759,402
Total Regionally Owned At-Sea Processing Employment (FTE)		0	-5	0	-5	0	-10	0	-11
Total Shore Based Processing Employment in the Region (FTE)		0	-6	-4	-10	0	-7	-5	-12
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	-1	-1	-2	0	-2	-2	-4
Total Processing Employment Accruing to the Region (FTE)		0	-12	-6	-18	0	-19	-7	-26
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-407	-1,817,501	-838,600	-2,656,508	-407	-2,520,047	-1,212,609	-3,733,063
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	-36	-8	-44	0	-49	-11	-60

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-19 Alternative 2 - Southcentral region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

03-Alaska Southcentral Region	High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
	Annual Summary Table	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock
Total Regionally Owned CV Harvest (Tons)		-67%	-35%	-46%	-38%	-67%	-43%	-79%
Total Ex-Vessel Value (\$)		-67%	-36%	-46%	-37%	-67%	-44%	-79%
Total Catcher Vessel Payments to Labor (\$)		-67%	-36%	-46%	-37%	-67%	-44%	-79%
Total CV Employment (FTE)		-67%	-30%	-49%	-31%	-67%	-37%	-82%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	-37%	-56%	-40%	0%	-44%	-71%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	-15%	-19%	-15%	0%	-27%	-30%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-34%	-56%	-43%	0%	-41%	-71%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-25%	-49%	-37%	-67%	-37%	-81%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	-12%	-19%	-12%	0%	-24%	-30%
Total Shore Based Processed Value in the Region (\$)		0%	-33%	-56%	-40%	0%	-40%	-67%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-26%	-48%	-33%	-69%	-38%	-78%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	-12%	-19%	-12%	0%	-24%	-30%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-33%	-56%	-40%	0%	-40%	-67%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-26%	-48%	-33%	-69%	-38%	-78%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-22%	-50%	-28%	-69%	-33%	-70%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	-12%	-19%	-12%	0%	-24%	-30%
Total Shore Based Processing Employment in the Region (FTE)		0%	-33%	-56%	-40%	0%	-40%	-67%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-27%	-48%	-34%	-69%	-40%	-79%
Total Processing Employment Accruing to the Region (FTE)		-67%	-19%	-49%	-23%	-69%	-30%	-65%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-25%	-49%	-30%	-67%	-35%	-72%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-25%	-49%	-27%	-67%	-34%	-70%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-20 Alternative 2 - Southeast region groundfish fishery socioeconomic indicators

04-Alaska Southeast Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		8	4,038	377	4,423	8	3,555	86	3,648
Total Ex-Vessel Value (\$)		600	3,068,246	94,071	3,162,917	600	2,719,709	21,384	2,741,693
Total Catcher Vessel Payments to Labor (\$)		240	1,227,298	37,629	1,265,167	240	1,087,883	8,554	1,096,677
Total CV Employment (FTE)		0	65	1	65	0	58	0	58
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	1,396,782	96	1,396,878	0	1,268,613	86	1,268,700
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	6,574	290	6,864	0	5,646	246	5,892
Total Shore Based Processing in the Region (Round-Weight Tons)		0	1,669	0	1,670	0	1,516	0	1,516
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	7,136	290	7,426	0	6,156	246	6,403
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	7,486,296	226,985	7,713,280	0	6,423,709	192,575	6,616,283
Total Shore Based Processed Value in the Region (\$)		0	2,885,468	416	2,885,884	0	2,623,287	377	2,623,664
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	8,458,128	227,125	8,685,253	0	7,307,238	192,702	7,499,940
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,245,889	68,095	2,313,984	0	1,927,113	57,772	1,984,885
Total Shore Based Processing Payments to Labor in the Region (\$)		0	865,641	125	865,765	0	786,986	113	787,099
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	845,813	22,712	868,525	0	730,724	19,270	749,994
Total Processing Payments to Labor Accruing to the Region (\$)		0	3,957,342	90,933	4,048,275	0	3,444,823	77,156	3,521,978
Total Regionally Owned At-Sea Processing Employment (FTE)		0	41	1	42	0	35	1	36
Total Shore Based Processing Employment in the Region (FTE)		0	4	0	4	0	3	0	3
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	2	0	2	0	2	0	2
Total Processing Employment Accruing to the Region (FTE)		0	47	1	48	0	40	1	41
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		240	5,184,640	128,561	5,313,441	240	4,532,706	85,709	4,618,655
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	111	2	114	0	98	1	99

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-21 Alternative 2 - Southeast region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

04-Alaska Southeast Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-16	-2,439	-465	-2,920	-16	-2,874	-746	-3,636
Total Ex-Vessel Value (\$)		-1,200	-2,032,028	-115,986	-2,149,215	-1,200	-2,346,556	-185,924	-2,533,680
Total Catcher Vessel Payments to Labor (\$)		-480	-812,811	-46,394	-859,686	-480	-938,622	-74,370	-1,013,472
Total CV Employment (FTE)		0	-37	-1	-38	0	-44	-2	-45
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-850,386	-120	-850,506	0	-978,517	-130	-978,647
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	-1,133	-67	-1,201	0	-2,041	-105	-2,146
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-1,015	0	-1,016	0	-1,169	-1	-1,169
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	-1,475	-67	-1,543	0	-2,435	-106	-2,540
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	-1,014,573	-52,603	-1,067,176	0	-2,053,952	-83,016	-2,136,967
Total Shore Based Processed Value in the Region (\$)		0	-1,760,987	-523	-1,761,509	0	-2,023,102	-561	-2,023,663
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-1,607,678	-52,779	-1,660,457	0	-2,735,338	-83,205	-2,818,542
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	-304,372	-15,781	-320,153	0	-616,186	-24,905	-641,090
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-528,296	-157	-528,453	0	-606,931	-168	-607,099
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-160,768	-5,278	-166,046	0	-273,534	-8,320	-281,854
Total Processing Payments to Labor Accruing to the Region (\$)		0	-993,436	-21,216	-1,014,651	0	-1,496,650	-33,394	-1,530,043
Total Regionally Owned At-Sea Processing Employment (FTE)		0	-6	0	-6	0	-11	0	-12
Total Shore Based Processing Employment in the Region (FTE)		0	-2	0	-2	0	-3	0	-3
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	-1	0	-1
Total Processing Employment Accruing to the Region (FTE)		0	-8	0	-8	0	-14	0	-15
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-480	-1,806,247	-67,610	-1,874,337	-480	-2,435,272	-107,763	-2,543,515
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	-45	-1	-47	0	-58	-2	-60

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-22 Alternative 2 - Southeast region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

04-Alaska Southeast Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-38%	-55%	-40%	-67%	-45%	-90%	-50%
Total Ex-Vessel Value (\$)		-67%	-40%	-55%	-40%	-67%	-46%	-90%	-48%
Total Catcher Vessel Payments to Labor (\$)		-67%	-40%	-55%	-40%	-67%	-46%	-90%	-48%
Total CV Employment (FTE)		-67%	-37%	-55%	-37%	-67%	-43%	-90%	-44%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	-38%	-56%	-38%	0%	-44%	-60%	-44%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	-15%	-19%	-15%	0%	-27%	-30%	-27%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-38%	-56%	-38%	0%	-44%	-60%	-44%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	-17%	-19%	-17%	0%	-28%	-30%	-28%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	-12%	-19%	-12%	0%	-24%	-30%	-24%
Total Shore Based Processed Value in the Region (\$)		0%	-38%	-56%	-38%	0%	-44%	-60%	-44%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	-16%	-19%	-16%	0%	-27%	-30%	-27%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	-12%	-19%	-12%	0%	-24%	-30%	-24%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-38%	-56%	-38%	0%	-44%	-60%	-44%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	-16%	-19%	-16%	0%	-27%	-30%	-27%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	-20%	-19%	-20%	0%	-30%	-30%	-30%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	-12%	-19%	-12%	0%	-24%	-30%	-24%
Total Shore Based Processing Employment in the Region (FTE)		0%	-38%	-56%	-38%	0%	-44%	-60%	-44%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	-13%	-19%	-13%	0%	-25%	-30%	-25%
Total Processing Employment Accruing to the Region (FTE)		0%	-15%	-19%	-15%	0%	-26%	-30%	-26%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-26%	-34%	-26%	-67%	-35%	-56%	-36%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-29%	-39%	-29%	-67%	-37%	-64%	-38%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-23 Alternative 2 - Washington inland waters region groundfish fishery socioeconomic indicators

05-Washington Inland Waters Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		91	21,298	575,129	596,518	43	11,375	379,351	390,769
Total Ex-Vessel Value (\$)		6,881	14,129,903	140,867,268	155,004,052	3,237	7,870,076	92,902,018	100,775,331
Total Catcher Vessel Payments to Labor (\$)		2,752	5,651,961	56,346,907	62,001,621	1,295	3,148,030	37,160,807	40,310,132
Total CV Employment (FTE)		0	128	294	422	0	102	189	291
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		19,321	89,453	627,224	735,998	8,282	74,403	527,706	610,391
Total Shore Based Processing in the Region (Round-Weight Tons)		0	12	0	12	0	10	0	11
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		19,447	131,816	1,122,796	1,274,058	8,354	98,270	824,728	931,353
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		8,144,792	102,852,023	485,977,938	596,974,752	3,491,280	85,403,920	407,897,855	496,793,055
Total Shore Based Processed Value in the Region (\$)		0	19,933	13	19,947	0	18,119	12	18,131
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		8,185,340	162,220,343	818,666,174	989,071,857	3,508,755	119,663,020	609,116,895	732,288,670
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		2,438,283	29,995,477	126,285,828	158,719,588	1,045,175	24,814,699	105,974,829	131,834,703
Total Shore Based Processing Payments to Labor in the Region (\$)		0	5,980	4	5,984	0	5,436	4	5,439
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		818,534	16,222,034	81,866,617	98,907,186	350,876	11,966,302	60,911,690	73,228,867
Total Processing Payments to Labor Accruing to the Region (\$)		3,256,817	46,223,491	208,152,449	257,632,758	1,396,051	36,786,436	166,886,522	205,069,009
Total Regionally Owned At-Sea Processing Employment (FTE)		73	634	2,250	2,956	31	516	1,890	2,437
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		4	52	226	282	2	37	163	202
Total Processing Employment Accruing to the Region (FTE)		76	685	2,476	3,238	33	553	2,053	2,639
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		3,259,569	51,875,453	264,499,356	319,634,378	1,397,345	39,934,467	204,047,330	245,379,142
Total Harvesting and Processing Employment Accruing to the Region (FTE)		76	813	2,770	3,659	33	655	2,242	2,930

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-24 Alternative 2 - Washington Inland waters region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

05-Washington Inland Waters Region				High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table				Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)				-185	-20,640	-213,348	-234,173	-174	-29,635	-401,547	-431,355
Total Ex-Vessel Value (\$)				-13,950	-13,345,189	-52,283,388	-65,642,527	-13,082	-19,018,276	-98,391,494	-117,422,852
Total Catcher Vessel Payments to Labor (\$)				-5,580	-5,338,075	-20,913,355	-26,257,011	-5,233	-7,607,311	-39,356,598	-46,969,141
Total CV Employment (FTE)				0	-86	-118	-203	0	-109	-218	-327
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)				-39,230	-21,764	-145,671	-206,666	-35,852	-34,674	-233,738	-304,263
Total Shore Based Processing in the Region (Round-Weight Tons)				0	-7	0	-7	0	-8	0	-8
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)				-39,486	-61,528	-365,986	-467,001	-36,095	-91,299	-647,740	-775,134
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)				-16,538,011	-20,433,076	-112,796,661	-149,767,748	-15,114,433	-35,529,464	-181,986,506	-232,630,403
Total Shore Based Processed Value in the Region (\$)				0	-12,455	-17	-12,472	0	-14,262	-18	-14,280
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)				-16,620,302	-74,841,689	-257,636,689	-349,098,680	-15,191,241	-112,826,679	-455,036,662	-583,054,583
Total Regionally Owned At-Sea Processing Payments to Labor (\$)				-4,950,937	-6,057,771	-29,309,555	-40,318,263	-4,524,787	-10,550,169	-47,311,383	-62,386,338
Total Shore Based Processing Payments to Labor in the Region (\$)				0	-3,737	-5	-3,742	0	-4,279	-5	-4,284
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)				-1,662,030	-7,484,169	-25,763,669	-34,909,868	-1,519,124	-11,282,668	-45,503,666	-58,305,458
Total Processing Payments to Labor Accruing to the Region (\$)				-6,612,967	-13,545,677	-55,073,229	-75,231,873	-6,043,911	-21,837,116	-92,815,054	-120,696,081
Total Regionally Owned At-Sea Processing Employment (FTE)				-148	-133	-525	-805	-135	-233	-844	-1,211
Total Shore Based Processing Employment in the Region (FTE)				0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)				-7	-25	-76	-109	-7	-38	-136	-181
Total Processing Employment Accruing to the Region (FTE)				-155	-158	-601	-914	-142	-271	-980	-1,392
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)				-6,618,547	-18,883,752	-75,986,584	-101,488,883	-6,049,144	-29,444,426	-132,171,652	-167,665,222
Total Harvesting and Processing Employment Accruing to the Region (FTE)				-155	-244	-719	-1,117	-142	-380	-1,198	-1,720

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-25 Alternative 2 - Washington inland waters region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

05-Washington Inland Waters Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-49%	-27%	-28%	-80%	-72%	-51%	-52%
Total Ex-Vessel Value (\$)		-67%	-49%	-27%	-30%	-80%	-71%	-51%	-54%
Total Catcher Vessel Payments to Labor (\$)		-67%	-49%	-27%	-30%	-80%	-71%	-51%	-54%
Total CV Employment (FTE)		-67%	-40%	-29%	-33%	-73%	-52%	-54%	-53%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		-67%	-20%	-19%	-22%	-81%	-32%	-31%	-33%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-38%	-56%	-38%	0%	-44%	-59%	-44%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-32%	-25%	-27%	-81%	-48%	-44%	-45%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		-67%	-17%	-19%	-20%	-81%	-29%	-31%	-32%
Total Shore Based Processed Value in the Region (\$)		0%	-38%	-56%	-38%	0%	-44%	-59%	-44%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-32%	-24%	-26%	-81%	-49%	-43%	-44%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		-67%	-17%	-19%	-20%	-81%	-30%	-31%	-32%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-38%	-56%	-38%	0%	-44%	-59%	-44%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-32%	-24%	-26%	-81%	-49%	-43%	-44%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-23%	-21%	-23%	-81%	-37%	-36%	-37%
Total Regionally Owned At-Sea Processing Employment (FTE)		-67%	-17%	-19%	-21%	-81%	-31%	-31%	-33%
Total Shore Based Processing Employment in the Region (FTE)		0%	-38%	-56%	-38%	0%	-44%	-59%	-44%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-33%	-25%	-28%	-81%	-51%	-45%	-47%
Total Processing Employment Accruing to the Region (FTE)		-67%	-19%	-20%	-22%	-81%	-33%	-32%	-35%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-27%	-22%	-24%	-81%	-42%	-39%	-41%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-23%	-21%	-23%	-81%	-37%	-35%	-37%

Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-26 Alternative 2 - Oregon Coast region groundfish fishery socioeconomic indicators

06-Oregon Coast Region				High				Low			
Annual Summary Table				Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)				0	7,243	52,067	59,310	0	3,172	29,836	33,009
Total Ex-Vessel Value (\$)				21	4,679,210	12,753,380	17,432,612	17	2,126,483	7,307,478	9,433,978
Total Catcher Vessel Payments to Labor (\$)				9	1,871,684	5,101,352	6,973,045	7	850,593	2,922,991	3,773,591
Total CV Employment (FTE)				0	30	44	74	0	18	23	42
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)				0	0	0	0	0	0	0	0
Total Shore Based Processing in the Region (Round-Weight Tons)				0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)				0	0	0	0	0	0	0	0
Total Shore Based Processed Value in the Region (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Payments to Labor (\$)				0	0	0	0	0	0	0	0
Total Shore Based Processing Payments to Labor in the Region (\$)				0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)				0	0	0	0	0	0	0	0
Total Processing Payments to Labor Accruing to the Region (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Employment (FTE)				0	0	0	0	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)				0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)				0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)				0	0	0	0	0	0	0	0
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)				9	1,871,684	5,101,352	6,973,045	7	850,593	2,922,991	3,773,591
Total Harvesting and Processing Employment Accruing to the Region (FTE)				0	30	44	74	0	18	23	42

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-27 Alternative 2 - Oregon Coast region groundfish fishery socioeconomic indicators difference from alternative 1 (baseline)

06-Oregon Coast Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-1	-6,824	-26,995	-33,820	-1	-10,608	-48,548	-59,157
Total Ex-Vessel Value (\$)		-43	-4,304,980	-6,614,639	-10,919,662	-42	-6,677,698	-11,894,407	-18,572,146
Total Catcher Vessel Payments to Labor (\$)		-17	-1,721,992	-2,645,855	-4,367,865	-17	-2,671,079	-4,757,763	-7,428,859
Total CV Employment (FTE)		0	-24	-26	-50	0	-35	-47	-82
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	0	0	0	0	0	0	0
Total Processing Payments to Labor Accruing to the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Employment (FTE)		0	0	0	0	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	0	0	0	0	0	0	0
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-17	-1,721,992	-2,645,855	-4,367,865	-17	-2,671,079	-4,757,763	-7,428,859
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	-24	-26	-50	0	-35	-47	-82

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-28 Alternative 2 - Oregon Coast region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

06-Oregon Coast Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-49%	-34%	-36%	-71%	-77%	-62%	-64%
Total Ex-Vessel Value (\$)		-67%	-48%	-34%	-39%	-71%	-76%	-62%	-66%
Total Catcher Vessel Payments to Labor (\$)		-67%	-48%	-34%	-39%	-71%	-76%	-62%	-66%
Total CV Employment (FTE)		-67%	-44%	-37%	-40%	-68%	-66%	-67%	-66%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processed Value in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing Employment in the Region (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Processing Employment Accruing to the Region (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-48%	-34%	-39%	-71%	-76%	-62%	-66%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-44%	-37%	-40%	-68%	-66%	-67%	-66%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-29 Alternative 4 - All regions groundfish fishery socioeconomic indicators

Annual Summary Table	All Regions				High				Low			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)	403	100,269	972,583	1,073,255	360	90,284	925,008	1,015,652				
Total Ex-Vessel Value (\$)	30,352	67,399,250	238,300,022	305,729,624	27,078	60,628,286	226,631,439	287,286,803				
Total Catcher Vessel Payments to Labor (\$)	12,141	26,959,700	95,320,009	122,291,850	10,831	24,251,314	90,652,576	114,914,721				
Total CV Employment (FTE)	0	753	602	1,355	0	661	567	1,229				
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	30,978	63,894,624	175,769,108	239,694,711	27,690	57,812,902	168,134,455	225,975,046				
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	67,477	137,013	778,875	983,366	52,608	129,412	750,173	932,192				
Total Shore Based Processing in the Region (Round-Weight Tons)	412	94,679	717,244	812,334	368	85,750	686,139	772,258				
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	67,876	226,953	1,517,213	1,812,042	52,959	211,529	1,457,954	1,722,442				
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	28,445,925	151,843,757	603,383,505	783,673,188	22,181,353	142,960,652	580,428,777	745,570,782				
Total Shore Based Processed Value in the Region (\$)	114,955	133,658,252	474,117,448	607,890,655	96,297	120,867,023	454,300,380	575,263,700				
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	28,568,826	277,882,465	1,093,834,530	1,400,285,821	22,284,288	257,854,788	1,051,185,200	1,331,324,275				
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	8,518,157	44,314,336	156,973,504	209,805,997	6,642,324	41,803,267	150,979,353	199,424,944				
Total Shore Based Processing Payments to Labor in the Region (\$)	34,487	40,097,476	142,235,234	182,367,196	28,889	36,260,107	136,290,114	172,579,110				
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	2,856,883	27,788,247	109,383,453	140,028,582	2,228,429	25,785,479	105,118,520	133,132,428				
Total Processing Payments to Labor Accruing to the Region (\$)	11,409,526	112,200,058	408,592,191	532,201,775	8,899,642	103,848,853	392,387,987	505,136,482				
Total Regionally Owned At-Sea Processing Employment (FTE)	254	958	2,815	4,026	198	887	2,708	3,793				
Total Shore Based Processing Employment in the Region (FTE)	1	902	3,262	4,164	1	810	3,123	3,934				
Total Administrative Employment of All Regionally Owned Processors (FTE)	13	90	309	412	10	83	297	390				
Total Processing Employment Accruing to the Region (FTE)	268	1,949	6,385	8,603	209	1,780	6,128	8,117				
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	11,421,666	139,159,758	503,912,200	654,493,625	8,910,473	128,100,167	483,040,563	620,051,203				
Total Harvesting and Processing Employment Accruing to the Region (FTE)	268	2,703	6,987	9,958	209	2,441	6,695	9,345				

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-30 Alternative 4 - All regions groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

All Regions		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	-2,640	0	-2,640	19	-10,733	-38,397	-49,112
Total Ex-Vessel Value (\$)		0	-2,035,333	-153	-2,035,485	1,400	-7,595,276	-9,418,737	-17,012,613
Total Catcher Vessel Payments to Labor (\$)		0	-814,133	-61	-814,194	560	-3,038,110	-3,767,495	-6,805,045
Total CV Employment (FTE)		0	19	0	19	0	-65	-30	-94
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-2,616,373	-457	-2,616,830	1,406	-7,553,784	-6,439,037	-13,991,415
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	3,148	0	3,147	1,746	-2,077	-17,169	-17,499
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-3,506	-2	-3,508	19	-10,650	-26,231	-36,862
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	-30	-3	-33	1,766	-11,338	-42,738	-52,310
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	3,184,780	-208	3,184,572	738,950	-3,060,151	-14,000,937	-16,322,138
Total Shore Based Processed Value in the Region (\$)		0	-5,120,552	-18,140	-5,138,692	8,029	-15,456,035	-16,601,211	-32,049,217
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-1,332,838	-17,156	-1,349,995	747,545	-16,350,072	-30,381,396	-45,983,922
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	787,644	-52	787,592	221,355	-950,649	-3,665,968	-4,395,262
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-1,536,166	-5,442	-1,541,608	2,409	-4,636,810	-4,980,363	-9,614,765
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-133,284	-1,716	-134,999	74,754	-1,635,007	-3,038,140	-4,598,392
Total Processing Payments to Labor Accruing to the Region (\$)		0	-881,805	-7,210	-889,015	298,519	-7,222,467	-11,684,471	-18,608,419
Total Regionally Owned At-Sea Processing Employment (FTE)		0	35	0	35	7	-15	-65	-74
Total Shore Based Processing Employment in the Region (FTE)		0	-38	0	-38	0	-113	-116	-229
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	-6	-9	-14
Total Processing Employment Accruing to the Region (FTE)		0	-3	0	-4	7	-134	-190	-317
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	-1,695,938	-7,271	-1,703,209	299,079	-10,260,577	-15,451,966	-25,413,464
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	15	0	15	7	-199	-220	-411

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-31 Alternative 4 - All regions groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

Annual Summary Table	High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)	0%	-3%	0%	0%	5%	-11%	-4%	-5%
Total Ex-Vessel Value (\$)	0%	-3%	0%	-1%	5%	-11%	-4%	-6%
Total Catcher Vessel Payments to Labor (\$)	0%	-3%	0%	-1%	5%	-11%	-4%	-6%
Total CV Employment (FTE)	0%	3%	0%	1%	1%	-9%	-5%	-7%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0%	-4%	0%	-1%	5%	-12%	-4%	-6%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)	0%	-4%	0%	0%	5%	-11%	-4%	-5%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	0%	0%	0%	0%	3%	-5%	-3%	-3%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processed Value in the Region (\$)	0%	-4%	0%	-1%	9%	-11%	-4%	-5%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	0%	0%	0%	0%	3%	-6%	-3%	-3%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processing Payments to Labor in the Region (\$)	0%	-4%	0%	-1%	9%	-11%	-4%	-5%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	0%	0%	0%	0%	3%	-6%	-3%	-3%
Total Processing Payments to Labor Accruing to the Region (\$)	0%	-1%	0%	0%	3%	-7%	-3%	-4%
Total Regionally Owned At-Sea Processing Employment (FTE)	0%	4%	0%	1%	3%	-2%	-2%	-2%
Total Shore Based Processing Employment in the Region (FTE)	0%	-4%	0%	-1%	9%	-12%	-4%	-6%
Total Administrative Employment of All Regionally Owned Processors (FTE)	0%	0%	0%	0%	3%	-6%	-3%	-4%
Total Processing Employment Accruing to the Region (FTE)	0%	0%	0%	0%	3%	-7%	-3%	-4%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	0%	-1%	0%	0%	3%	-7%	-3%	-4%
Total Harvesting and Processing Employment Accruing to the Region (FTE)	0%	1%	0%	0%	3%	-8%	-3%	-4%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-32 Alternative 4 - Alaska Peninsula/Aleutian Islands region groundfish fishery socioeconomic indicators

01-Alaska Peninsula/ Aleutian Islands Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		33	6,064	10,248	16,344	33	5,278	9,029	14,340
Total Ex-Vessel Value (\$)		2,453	4,119,396	2,545,697	6,667,546	2,453	3,589,868	2,242,697	5,835,017
Total Catcher Vessel Payments to Labor (\$)		981	1,647,758	1,018,279	2,667,018	981	1,435,947	897,079	2,334,007
Total CV Employment (FTE)		0	55	24	79	0	48	21	70
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		30,978	41,985,929	161,715,266	203,732,173	27,690	37,673,424	155,468,720	193,169,833
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	102	10	112	0	94	9	103
Total Shore Based Processing in the Region (Round-Weight Tons)		412	65,760	659,697	725,869	368	59,216	634,277	693,860
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		1	231	416	649	1	194	379	574
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	120,063	6,447	126,510	0	108,932	5,912	114,845
Total Shore Based Processed Value in the Region (\$)		114,955	89,362,936	441,916,015	531,393,906	96,297	80,132,231	425,150,171	505,378,699
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		4	308,567	249,142	557,712	4	255,029	228,240	483,273
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	34,402	1,754	36,156	0	31,444	1,616	33,060
Total Shore Based Processing Payments to Labor in the Region (\$)		34,487	26,808,881	132,574,804	159,418,172	28,889	24,039,669	127,545,051	151,613,610
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	30,857	24,914	55,771	0	25,503	22,824	48,327
Total Processing Payments to Labor Accruing to the Region (\$)		34,487	26,874,139	132,601,473	159,510,099	28,889	24,096,616	127,569,491	151,694,997
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	1	0	1
Total Shore Based Processing Employment in the Region (FTE)		1	629	3,035	3,665	1	561	2,919	3,481
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		1	630	3,036	3,666	1	562	2,919	3,482
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		35,468	28,521,898	133,619,752	162,177,118	29,870	25,532,563	128,466,570	154,029,004
Total Harvesting and Processing Employment Accruing to the Region (FTE)		1	684	3,060	3,745	1	611	2,941	3,552

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-33 Alternative 4 - Alaska Peninsula/Aleutian Islands region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

01-Alaska Peninsula/Aleutian Islands Region	Annual Summary Table	High Difference from Alternative 1 (Baseline)			Low Difference from Alternative 1 (Baseline)			Total		
		Atka	Pacific cod	Pollock	Atka	Pacific cod	Pollock	Atka	Pacific cod	Pollock
Total Regionally Owned CV Harvest (Tons)		0	-1,496	-2	0	-1,498	-1,101	0	-2,124	-1,101
Total Ex-Vessel Value (\$)		0	-1,006,837	-484	0	-1,007,322	-273,795	0	-1,431,931	-273,795
Total Catcher Vessel Payments to Labor (\$)		0	-402,735	-194	0	-402,929	-109,518	0	-572,772	-109,518
Total CV Employment (FTE)		0	-7	0	0	-7	-3	0	-12	-3
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-1,665,488	-2,335	0	-1,667,823	-5,107,851	0	-4,967,623	-5,107,851
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	6	0	0	6	-1	0	-2	-1
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-2,597	-9	0	-2,607	-20,780	19	-7,547	-20,780
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	-2	0	0	-2	-32	0	-36	-32
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	8,615	-1	0	8,614	-444	0	-1,790	-444
Total Shore Based Processed Value in the Region (\$)		0	-3,725,190	-5,180	0	-3,730,370	-13,658,019	8,029	-10,776,427	-13,658,019
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-6,350	-32	0	-6,382	-18,379	0	-54,506	-18,379
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,208	0	0	2,207	-114	0	-557	-114
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-1,117,557	-1,554	0	-1,119,111	-4,097,406	2,409	-3,232,928	-4,097,406
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-635	-3	0	-638	-1,838	0	-5,451	-1,838
Total Processing Payments to Labor Accruing to the Region (\$)		0	-1,115,985	-1,557	0	-1,117,542	-4,099,358	2,409	-3,238,936	-4,099,358
Total Regionally Owned At-Sea Processing Employment (FTE)		0	0	0	0	0	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)		0	-27	0	0	-27	-95	0	-79	-95
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	-27	0	0	-27	-95	0	-79	-95
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	-1,518,719	-1,751	0	-1,520,471	-4,208,876	2,409	-3,811,709	-4,208,876
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	-34	0	0	-34	-98	0	-91	-98

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

01-Alaska Peninsula/Aleutian Islands Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	-20%	0%	-8%	0%	-29%	-11%	-18%
Total Ex-Vessel Value (\$)		0%	-20%	0%	-13%	0%	-29%	-11%	-23%
Total Catcher Vessel Payments to Labor (\$)		0%	-20%	0%	-13%	0%	-29%	-11%	-23%
Total CV Employment (FTE)		0%	-12%	0%	-8%	0%	-20%	-11%	-18%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	-4%	0%	-1%	5%	-12%	-3%	-5%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	6%	0%	6%	3%	-2%	-8%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-4%	0%	0%	5%	-11%	-3%	-4%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	-1%	0%	0%	0%	-16%	-8%	-11%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	8%	0%	7%	3%	-2%	-7%	-2%
Total Shore Based Processed Value in the Region (\$)		0%	-4%	0%	-1%	9%	-12%	-3%	-5%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	-2%	0%	-1%	1%	-18%	-7%	-13%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	7%	0%	7%	3%	-2%	-7%	-2%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-4%	0%	-1%	9%	-12%	-3%	-5%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	-2%	0%	-1%	1%	-18%	-7%	-13%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	-4%	0%	-1%	9%	-12%	-3%	-5%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	16%	0%	15%	3%	0%	-9%	-1%
Total Shore Based Processing Employment in the Region (FTE)		0%	-4%	0%	-1%	9%	-12%	-3%	-5%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	2%	0%	1%	1%	-16%	-8%	-12%
Total Processing Employment Accruing to the Region (FTE)		0%	-4%	0%	-1%	9%	-12%	-3%	-5%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	-5%	0%	-1%	9%	-13%	-3%	-5%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	-5%	0%	-1%	8%	-13%	-3%	-5%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-35 Alternative 4 - Kodiak region groundfish fishery socioeconomic indicators

02-Alaska Kodiak Region	High				Low			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Annual Summary Table								
Total Regionally Owned CV Harvest (Tons)	32	19,881	41,976	61,889	32	17,342	38,836	56,210
Total Ex-Vessel Value (\$)	2,383	13,584,059	10,292,430	23,878,872	2,381	11,863,714	9,521,557	21,387,652
Total Catcher Vessel Payments to Labor (\$)	953	5,433,624	4,116,972	9,551,549	953	4,745,486	3,808,623	8,555,061
Total CV Employment (FTE)	0	185	52	237	0	161	47	208
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	16,904,907	13,466,374	30,371,281	0	15,315,272	12,099,433	27,414,705
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	1,552	3,914	999	6,465	1,210	3,724	972	5,907
Total Shore Based Processing in the Region (Round-Weight Tons)	0	22,756	55,141	77,897	0	20,592	49,544	70,135
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	1,552	8,441	11,963	21,956	1,210	7,821	10,823	19,854
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	654,421	4,392,974	775,551	5,822,946	510,349	4,165,448	754,794	5,430,591
Total Shore Based Processed Value in the Region (\$)	0	34,053,946	30,074,114	64,128,060	0	30,835,856	27,069,416	57,905,272
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	654,421	11,168,344	6,755,225	18,577,990	510,349	10,300,947	6,137,040	16,948,336
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	196,326	1,260,996	232,607	1,689,929	153,105	1,198,357	226,381	1,577,843
Total Shore Based Processing Payments to Labor in the Region (\$)	0	10,216,184	9,022,234	19,238,418	0	9,250,757	8,120,825	17,371,582
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	65,442	1,116,834	675,522	1,857,799	51,035	1,030,095	613,704	1,694,834
Total Processing Payments to Labor Accruing to the Region (\$)	261,768	12,594,014	9,930,364	22,786,146	204,140	11,479,208	8,960,910	20,644,258
Total Regionally Owned At-Sea Processing Employment (FTE)	6	26	7	38	5	24	6	35
Total Shore Based Processing Employment in the Region (FTE)	0	248	219	467	0	225	197	422
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	4	3	7	0	3	2	6
Total Processing Employment Accruing to the Region (FTE)	6	278	228	512	5	252	206	463
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	262,722	18,027,637	14,047,336	32,337,695	205,092	16,224,694	12,769,533	29,199,319
Total Harvesting and Processing Employment Accruing to the Region (FTE)	6	463	280	749	5	413	253	671

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-36 Alternative 4 - Kodiak region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

02-Alaska Kodiak Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	113	5	118	0	-2,140	-2,801	-4,941
Total Ex-Vessel Value (\$)		0	7,327	1,214	8,541	1	-1,526,713	-687,525	-2,214,237
Total Catcher Vessel Payments to Labor (\$)		0	2,931	486	3,416	0	-610,685	-275,010	-885,695
Total CV Employment (FTE)		0	10	0	10	0	-13	-4	-17
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-995,440	6,720	-988,721	0	-2,461,648	-1,306,017	-3,767,665
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	114	0	114	40	-35	-13	-7
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-1,094	28	-1,067	0	-3,081	-5,348	-8,428
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	-103	5	-98	40	-648	-1,076	-1,683
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	112,532	0	112,532	17,039	-65,511	-10,040	-58,512
Total Shore Based Processed Value in the Region (\$)		0	-1,726,393	8,592	-1,717,801	0	-4,687,600	-2,876,959	-7,564,559
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-230,769	1,708	-229,061	17,039	-997,606	-582,069	-1,562,636
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	26,308	0	26,308	5,112	-21,916	-3,012	-19,816
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-517,918	2,578	-515,340	0	-1,406,280	-863,088	-2,269,368
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-23,077	171	-22,906	1,704	-99,761	-58,207	-156,264
Total Processing Payments to Labor Accruing to the Region (\$)		0	-514,686	2,748	-511,938	6,815	-1,527,956	-924,306	-2,445,447
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)		0	-13	0	-13	0	-34	-21	-55
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	-1
Total Processing Employment Accruing to the Region (FTE)		0	-12	0	-12	0	-35	-21	-56
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	-511,755	3,234	-508,522	6,816	-2,138,642	-1,199,316	-3,331,142
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	-2	0	-2	0	-47	-25	-73

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-37 Alternative 4 - Kodiak region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

02-Alaska Kodiak Region	Annual Summary Table	High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	1%	0%	0%	0%	-11%	-7%	-8%
Total Ex-Vessel Value (\$)		0%	0%	0%	0%	0%	-11%	-7%	-9%
Total Catcher Vessel Payments to Labor (\$)		0%	0%	0%	0%	0%	-11%	-7%	-9%
Total CV Employment (FTE)		0%	6%	0%	4%	0%	-7%	-8%	-7%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	-6%	0%	-3%	0%	-14%	-10%	-12%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	3%	0%	2%	3%	-1%	-1%	0%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-5%	0%	-1%	0%	-13%	-10%	-11%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	-1%	0%	0%	3%	-8%	-9%	-8%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	3%	0%	2%	3%	-2%	-1%	-1%
Total Shore Based Processed Value in the Region (\$)		0%	-5%	0%	-3%	0%	-13%	-10%	-12%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	-2%	0%	-1%	3%	-9%	-9%	-8%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	2%	0%	2%	3%	-2%	-1%	-1%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-5%	0%	-3%	0%	-13%	-10%	-12%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	-2%	0%	-1%	3%	-9%	-9%	-8%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	-4%	0%	-2%	3%	-12%	-9%	-11%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	3%	0%	2%	3%	-1%	-1%	-1%
Total Shore Based Processing Employment in the Region (FTE)		0%	-5%	0%	-3%	0%	-13%	-10%	-12%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	-2%	0%	-1%	3%	-9%	-9%	-9%
Total Processing Employment Accruing to the Region (FTE)		0%	-4%	0%	-2%	3%	-12%	-9%	-11%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	-3%	0%	-2%	3%	-12%	-9%	-10%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	0%	0%	0%	3%	-10%	-9%	-10%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-38 Alternative 4 - Southcentral region groundfish fishery socioeconomic indicators

03-Alaska Southcentral Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		20	6,216	2,888	9,124	20	5,357	2,638	8,015
Total Ex-Vessel Value (\$)		1,511	4,497,999	708,416	5,207,926	1,511	3,899,188	646,981	4,547,680
Total Catcher Vessel Payments to Labor (\$)		605	1,799,199	283,366	2,083,170	604	1,559,675	258,793	1,819,072
Total CV Employment (FTE)		0	89	4	93	0	78	4	82
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	2,760,719	587,255	3,347,974	0	2,581,623	566,089	3,147,712
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	7,078	322	7,400	0	6,809	311	7,120
Total Shore Based Processing in the Region (Round-Weight Tons)		0	3,462	2,405	5,867	0	3,243	2,318	5,561
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		15	12,155	11,405	23,574	15	11,204	10,416	21,634
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	7,758,842	252,059	8,010,901	0	7,448,846	243,128	7,691,974
Total Shore Based Processed Value in the Region (\$)		0	5,579,257	2,126,362	7,705,620	0	5,237,840	2,079,838	7,317,678
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		56	15,453,650	6,961,639	22,415,345	53	14,134,206	6,411,215	20,545,475
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,327,653	75,618	2,403,270	0	2,234,654	72,938	2,307,592
Total Shore Based Processing Payments to Labor in the Region (\$)		0	1,673,777	637,909	2,311,686	0	1,571,352	623,951	2,195,303
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		6	1,545,365	696,164	2,241,534	5	1,413,421	641,122	2,054,548
Total Processing Payments to Labor Accruing to the Region (\$)		6	5,546,795	1,409,690	6,956,491	5	5,219,427	1,338,011	6,557,443
Total Regionally Owned At-Sea Processing Employment (FTE)		0	43	1	44	0	41	1	42
Total Shore Based Processing Employment in the Region (FTE)		0	19	7	27	0	18	7	25
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	5	2	7	0	4	2	6
Total Processing Employment Accruing to the Region (FTE)		0	66	11	78	0	63	11	74
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		610	7,345,994	1,693,057	9,039,661	610	6,779,102	1,596,804	8,376,515
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	155	15	170	0	141	15	156

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-39 Alternative 4 - Southcentral region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

03-Alaska Southcentral Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	348	0	348	0	-456	-229	-684
Total Ex-Vessel Value (\$)		0	168,100	115	168,214	0	-393,770	-56,115	-449,884
Total Catcher Vessel Payments to Labor (\$)		0	67,240	46	67,286	0	-157,508	-22,446	-179,954
Total CV Employment (FTE)		0	8	0	8	0	-2	0	-2
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	48,654	-4,839	43,815	0	-119,966	-25,165	-145,131
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	129	0	129	0	-121	-7	-127
Total Shore Based Processing in the Region (Round-Weight Tons)		0	188	-20	168	0	-19	-103	-122
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	3	-7	-4	0	-865	-911	-1,776
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	94,996	0	94,996	0	-194,076	-5,327	-199,404
Total Shore Based Processed Value in the Region (\$)		0	347,762	-21,540	326,222	0	25,667	-66,220	-40,552
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-102,512	-9,122	-111,634	0	-1,305,135	-510,071	-1,815,205
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	28,499	0	28,499	0	-58,223	-1,598	-59,821
Total Shore Based Processing Payments to Labor in the Region (\$)		0	104,328	-6,462	97,867	0	7,700	-19,866	-12,166
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-10,251	-912	-11,163	0	-130,513	-51,007	-181,521
Total Processing Payments to Labor Accruing to the Region (\$)		0	122,576	-7,374	115,202	0	-181,036	-72,471	-253,507
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	-1	0	-1
Total Shore Based Processing Employment in the Region (FTE)		0	1	0	1	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	-1
Total Processing Employment Accruing to the Region (FTE)		0	2	0	2	0	-1	0	-2
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	189,816	-7,328	182,488	0	-338,544	-94,917	-433,461
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	10	0	10	0	-3	-1	-4

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives and therefore do not change the relative impacts or ranking of the alternatives.

Table 4.12-40 Alternative 4 - Southcentral region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

03-Alaska Southcentral Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	6%	0%	4%	0%	-8%	-8%	-8%
Total Ex-Vessel Value (\$)		0%	4%	0%	3%	0%	-9%	-8%	-9%
Total Catcher Vessel Payments to Labor (\$)		0%	4%	0%	3%	0%	-9%	-8%	-9%
Total CV Employment (FTE)		0%	10%	0%	10%	0%	-2%	-9%	-2%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	2%	-1%	1%	0%	-4%	-4%	-4%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	2%	0%	2%	0%	-2%	-2%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	6%	-1%	3%	0%	-1%	-4%	-2%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	0%	0%	0%	0%	-7%	-8%	-8%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	1%	0%	1%	0%	-3%	-2%	-3%
Total Shore Based Processed Value in the Region (\$)		0%	7%	-1%	4%	0%	0%	-3%	-1%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	-1%	0%	0%	1%	-8%	-7%	-8%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	1%	0%	1%	0%	-3%	-2%	-3%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	7%	-1%	4%	0%	0%	-3%	-1%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	-1%	0%	0%	1%	-8%	-7%	-8%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	2%	-1%	2%	1%	-3%	-5%	-4%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	1%	0%	1%	0%	-3%	-2%	-3%
Total Shore Based Processing Employment in the Region (FTE)		0%	7%	-1%	4%	0%	0%	-3%	-1%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	-2%	0%	-1%	1%	-10%	-8%	-9%
Total Processing Employment Accruing to the Region (FTE)		0%	3%	-1%	2%	1%	-2%	-4%	-2%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	3%	0%	2%	0%	-5%	-6%	-5%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	7%	0%	6%	0%	-2%	-5%	-2%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-41 Alternative 4 - Southeast region groundfish fishery socioeconomic indicators

04-Alaska Southeast Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		24	6,558	843	7,424	24	5,988	739	6,731
Total Ex-Vessel Value (\$)		1,800	5,020,887	210,004	5,232,691	1,800	4,570,797	184,229	4,756,826
Total Catcher Vessel Payments to Labor (\$)		720	2,008,355	84,002	2,093,077	720	1,828,319	73,692	1,902,730
Total CV Employment (FTE)		0	103	2	105	0	95	2	96
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	2,243,069	214	2,243,283	0	2,242,583	213	2,242,796
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	7,851	357	8,208	0	7,553	344	7,897
Total Shore Based Processing in the Region (Round-Weight Tons)		0	2,682	1	2,683	0	2,681	1	2,682
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	8,754	357	9,111	0	8,456	345	8,800
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	8,606,240	279,588	8,885,828	0	8,262,387	269,681	8,532,069
Total Shore Based Processed Value in the Region (\$)		0	4,630,024	926	4,630,950	0	4,629,111	925	4,630,037
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	10,165,643	279,900	10,445,543	0	9,821,483	269,993	10,091,476
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	2,581,872	83,876	2,665,748	0	2,478,716	80,904	2,559,621
Total Shore Based Processing Payments to Labor in the Region (\$)		0	1,389,007	278	1,389,285	0	1,388,733	278	1,389,011
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	1,016,564	27,990	1,044,554	0	982,148	26,999	1,009,148
Total Processing Payments to Labor Accruing to the Region (\$)		0	4,987,443	112,144	5,099,588	0	4,849,598	108,181	4,957,779
Total Regionally Owned At-Sea Processing Employment (FTE)		0	47	2	49	0	45	1	47
Total Shore Based Processing Employment in the Region (FTE)		0	6	0	6	0	6	0	6
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	2	0	3	0	2	0	2
Total Processing Employment Accruing to the Region (FTE)		0	55	2	57	0	53	2	55
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		720	6,995,798	196,146	7,192,664	720	6,677,917	181,873	6,860,510
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	158	4	162	0	148	3	151

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-42 Alternative 4 - Southeast region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

04-Alaska Southeast Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	81	0	81	0	-460	-93	-553
Total Ex-Vessel Value (\$)		0	-79,387	-54	-79,441	0	-495,468	-23,078	-518,546
Total Catcher Vessel Payments to Labor (\$)		0	-31,755	-21	-31,776	0	-198,187	-9,231	-207,418
Total CV Employment (FTE)		0	1	0	1	0	-7	0	-7
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	-4,099	-3	-4,101	0	-4,548	-3	-4,551
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	143	0	143	0	-134	-7	-141
Total Shore Based Processing in the Region (Round-Weight Tons)		0	-3	0	-3	0	-3	0	-3
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	142	0	142	0	-135	-7	-143
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	105,371	0	105,371	0	-215,273	-5,909	-221,182
Total Shore Based Processed Value in the Region (\$)		0	-16,431	-12	-16,443	0	-17,278	-13	-17,291
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	99,837	-4	99,833	0	-221,092	-5,913	-227,006
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	31,611	0	31,611	0	-64,582	-1,773	-66,355
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-4,929	-4	-4,933	0	-5,183	-4	-5,187
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	9,984	0	9,983	0	-22,109	-591	-22,701
Total Processing Payments to Labor Accruing to the Region (\$)		0	36,666	-4	36,662	0	-91,875	-2,368	-94,243
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	-1	0	-1
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	1	0	1	0	-1	0	-1
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	4,911	-25	4,886	0	-290,062	-11,599	-301,661
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	2	0	2	0	-8	0	-8

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-43 Alternative 4 - Southeast Region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

04-Alaska Southeast Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	1%	0%	1%	0%	0%	-7%	-11%
Total Ex-Vessel Value (\$)		0%	-2%	0%	-1%	0%	0%	-10%	-10%
Total Catcher Vessel Payments to Labor (\$)		0%	-2%	0%	-1%	0%	0%	-10%	-10%
Total CV Employment (FTE)		0%	1%	0%	1%	0%	0%	-6%	-7%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	-1%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	2%	0%	2%	0%	0%	-2%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	0%	-1%	0%	0%	0%	0%	0%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	2%	0%	2%	0%	0%	-2%	-2%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	1%	0%	1%	0%	0%	-3%	-3%
Total Shore Based Processed Value in the Region (\$)		0%	0%	-1%	0%	0%	0%	0%	0%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	1%	0%	1%	0%	0%	-2%	-2%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	1%	0%	1%	0%	0%	-3%	-3%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	0%	-1%	0%	0%	0%	0%	0%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	1%	0%	1%	0%	0%	-2%	-2%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	1%	0%	1%	0%	0%	-2%	-2%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	1%	0%	1%	0%	0%	-3%	-3%
Total Shore Based Processing Employment in the Region (FTE)		0%	0%	-1%	0%	0%	0%	0%	0%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	1%	0%	1%	0%	0%	-2%	-2%
Total Processing Employment Accruing to the Region (FTE)		0%	1%	0%	1%	0%	0%	-2%	-2%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	0%	0%	0%	0%	0%	-4%	-4%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	1%	0%	1%	0%	0%	-5%	-5%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-44 Alternative 4 - Washington inland waters region groundfish fishery socioeconomic indicators

05-Washington Inland Waters Region				High				Low			
Annual Summary Table				Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)				277	40,650	788,461	829,387	235	36,890	753,051	790,175
Total Ex-Vessel Value (\$)				20,831	26,623,179	193,146,758	219,790,768	17,670	24,117,551	184,466,148	208,601,369
Total Catcher Vessel Payments to Labor (\$)				8,332	10,649,272	77,258,703	87,916,307	7,068	9,647,020	73,786,459	83,440,548
Total CV Employment (FTE)				0	217	411	628	0	185	391	577
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)				0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)				58,551	113,766	772,895	945,212	45,648	107,303	744,367	897,317
Total Shore Based Processing in the Region (Round-Weight Tons)				0	19	0	19	0	19	0	19
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)				58,934	193,069	1,488,781	1,740,783	45,984	179,925	1,431,821	1,657,730
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)				24,682,802	125,878,726	598,774,427	749,335,955	19,246,686	118,368,982	575,951,929	713,567,596
Total Shore Based Processed Value in the Region (\$)				0	32,089	30	32,119	0	31,984	30	32,014
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)				24,805,643	235,699,349	1,076,293,192	1,336,798,183	19,349,564	218,737,065	1,034,935,378	1,273,022,007
Total Regionally Owned At-Sea Processing Payments to Labor (\$)				7,389,220	36,689,139	155,595,340	199,673,699	5,761,924	34,568,391	149,640,320	189,970,635
Total Shore Based Processing Payments to Labor in the Region (\$)				0	9,627	9	9,636	0	9,595	9	9,604
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)				2,480,564	23,569,935	107,629,319	133,679,818	1,934,956	21,873,707	103,493,538	127,302,201
Total Processing Payments to Labor Accruing to the Region (\$)				9,869,784	60,268,701	263,224,668	333,363,153	7,696,880	56,451,693	253,133,867	317,282,440
Total Regionally Owned At-Sea Processing Employment (FTE)				220	795	2,775	3,790	172	736	2,669	3,577
Total Shore Based Processing Employment in the Region (FTE)				0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)				11	77	302	391	9	71	291	370
Total Processing Employment Accruing to the Region (FTE)				231	872	3,077	4,181	180	806	2,960	3,947
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)				9,878,116	70,917,973	340,483,371	421,279,460	7,703,948	66,098,713	326,920,327	400,722,988
Total Harvesting and Processing Employment Accruing to the Region (FTE)				231	1,089	3,488	4,809	181	991	3,352	4,524

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-45 Alternative 4 - Washington inland waters region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

05-Washington Inland Waters Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	-1,288	-16	-1,304	18	-4,121	-27,847	-31,950
Total Ex-Vessel Value (\$)		0	-851,912	-3,898	-855,810	1,351	-2,770,801	-6,827,364	-9,596,814
Total Catcher Vessel Payments to Labor (\$)		0	-340,765	-1,559	-342,324	540	-1,108,321	-2,730,946	-3,838,726
Total CV Employment (FTE)		0	3	0	3	0	-26	-16	-42
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	2,549	0	2,549	1,514	-1,774	-17,077	-17,337
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	-276	-1	-276	1,534	-9,643	-40,648	-48,756
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	2,593,627	-172	2,593,455	640,973	-2,564,402	-13,932,433	-15,855,861
Total Shore Based Processed Value in the Region (\$)		0	-300	0	-300	0	-397	0	-397
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	-1,362,683	-9,671	-1,372,354	649,567	-13,752,634	-29,218,180	-42,321,246
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	635,891	-43	635,848	191,962	-796,477	-3,645,891	-4,250,406
Total Shore Based Processing Payments to Labor in the Region (\$)		0	-90	0	-90	0	-119	0	-119
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	-136,268	-967	-137,235	64,957	-1,375,263	-2,921,818	-4,232,125
Total Processing Payments to Labor Accruing to the Region (\$)		0	499,533	-1,010	498,522	256,919	-2,171,859	-6,567,709	-8,482,650
Total Regionally Owned At-Sea Processing Employment (FTE)		0	29	0	29	6	-13	-64	-71
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	-5	-9	-13
Total Processing Employment Accruing to the Region (FTE)		0	29	0	29	6	-17	-73	-84
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	158,768	-2,569	156,198	257,460	-3,280,180	-9,298,655	-12,321,375
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	32	0	32	6	-43	-89	-126

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-46 Alternative 4 - Washington inland waters region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

05-Washington Inland Waters Region		High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	-3%	0%	0%	8%	-10%	-4%	-4%
Total Ex-Vessel Value (\$)		0%	-3%	0%	0%	8%	-10%	-4%	-4%
Total Catcher Vessel Payments to Labor (\$)		0%	-3%	0%	0%	8%	-10%	-4%	-4%
Total CV Employment (FTE)		0%	2%	0%	1%	4%	-12%	-4%	-7%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	-1%	-1%	-1%	0%	-1%	-1%	-1%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	0%	0%	0%	3%	-5%	-3%	-3%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processed Value in the Region (\$)		0%	-1%	-1%	-1%	0%	-1%	-1%	-1%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	-1%	0%	0%	3%	-6%	-3%	-3%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	2%	0%	0%	3%	-2%	-2%	-2%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	-1%	-1%	-1%	0%	-1%	-1%	-1%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	-1%	0%	0%	3%	-6%	-3%	-3%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	1%	0%	0%	3%	-4%	-3%	-3%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	4%	0%	1%	3%	-2%	-2%	-2%
Total Shore Based Processing Employment in the Region (FTE)		0%	-1%	-1%	-1%	0%	-1%	-1%	-1%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	0%	0%	0%	3%	-6%	-3%	-3%
Total Processing Employment Accruing to the Region (FTE)		0%	3%	0%	1%	3%	-2%	-2%	-2%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	0%	0%	0%	3%	-5%	-3%	-3%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	3%	0%	1%	3%	-4%	-3%	-3%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-47 Alternative 4 - Oregon Coast region groundfish fishery socioeconomic indicators

06-Oregon Coast Region		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		1	13,723	79,071	92,795	1	12,856	74,304	87,161
Total Ex-Vessel Value (\$)		65	8,771,179	19,370,402	28,141,646	61	8,201,828	18,201,579	26,403,468
Total Catcher Vessel Payments to Labor (\$)		26	3,508,472	7,748,161	11,256,658	24	3,280,731	7,280,632	10,561,387
Total CV Employment (FTE)		0	54	71	125	0	49	66	114
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	0	0	0	0	0	0	0
Total Processing Payments to Labor Accruing to the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Employment (FTE)		0	0	0	0	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	0	0	0	0	0	0	0
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		26	3,508,472	7,748,161	11,256,658	24	3,280,731	7,280,632	10,561,387
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	54	71	125	0	49	66	114

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-48 Alternative 4 - Oregon Coast region groundfish fishery socioeconomic indicators difference from Alternative 1 (baseline)

06-Oregon Coast Region		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	-344	10	-335	0	-924	-4,081	-5,005
Total Ex-Vessel Value (\$)		0	-213,012	2,384	-210,629	2	-602,352	-1,000,306	-1,602,657
Total Catcher Vessel Payments to Labor (\$)		0	-85,205	953	-84,251	1	-240,941	-400,122	-641,063
Total CV Employment (FTE)		0	0	0	0	0	-4	-4	-9
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	0	0	0	0	0	0	0
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	0	0	0	0	0	0	0
Total Processing Payments to Labor Accruing to the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing Employment (FTE)		0	0	0	0	0	0	0	0
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	0	0
Total Processing Employment Accruing to the Region (FTE)		0	0	0	0	0	0	0	0
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	-85,205	953	-84,251	1	-240,941	-400,122	-641,063
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	0	0	0	0	-4	-4	-9

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

Table 4.12-49 Alternative 4 - Oregon Coast region groundfish fishery socioeconomic indicators percentage difference from Alternative 1 (baseline)

06-Oregon Coast Region	High Percent Difference from Alternative 1 (Baseline)				Low Percent Difference from Alternative 1 (Baseline)			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Annual Summary Table								
Total Regionally Owned CV Harvest (Tons)	0%	-2%	0%	0%	3%	-7%	0%	-5%
Total Ex-Vessel Value (\$)	0%	-2%	0%	-1%	3%	-7%	0%	-6%
Total Catcher Vessel Payments to Labor (\$)	0%	-2%	0%	-1%	3%	-7%	0%	-6%
Total CV Employment (FTE)	0%	0%	0%	0%	1%	-8%	0%	-7%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing in the Region (Round-Weight Tons)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processed Value in the Region (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing Payments to Labor in the Region (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Processing Payments to Labor Accruing to the Region (\$)	0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing Employment (FTE)	0%	0%	0%	0%	0%	0%	0%	0%
Total Shore Based Processing Employment in the Region (FTE)	0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Employment of All Regionally Owned Processors (FTE)	0%	0%	0%	0%	0%	0%	0%	0%
Total Processing Employment Accruing to the Region (FTE)	0%	0%	0%	0%	0%	0%	0%	0%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	0%	-2%	0%	-1%	3%	-7%	0%	-6%
Total Harvesting and Processing Employment Accruing to the Region (FTE)	0%	0%	0%	0%	1%	-8%	0%	-7%

Note: Total catches are adjusted to reflect regional differences in harvesting and processing efficiency from 1999 data. Because of the adjustments, total catches do not sum to be exactly equal to total catches for the alternatives in other sections of the analysis. The differences are minor, are found in all alternatives, and, therefore, do not change the relative impacts or ranking of the alternatives.

4.12.2.2.7 CDQ Region Effects

The CDQ Region as used in this analysis is defined along lines of vessel and processor ownership rather than on geographic terms. All catcher vessels and processors in which CDQ organizations currently have an ownership interest are included under this definition of the CDQ region (see Table 8 of Appendix F(4) for a listing CDQ ownership). Tables 4.12-50 through 4.12-56 provide data on engagement in the groundfish fishery as measured by the 21 socioeconomic indicators tracked for the other regions, both for the baseline (Alternative 1) and Alternatives 2 and 4. For Alternatives 2 and 4 additional information on absolute change from the baseline and percentage change from the baseline is also presented, consistent with the information presentation for other regions. All catches, processing amounts, revenues, payments to labor, etc., for the CDQ owned facilities are included in the tables.

In general, CDQ ownership shares in catcher vessels are larger than ownership shares in processors. An examination of revenues and CDQ ownership shares indicates that CDQ groups can claim an average of 50.1 percent ownership of the included catcher vessels and 27.0 percent ownership of the included processors. Thus to the extent that the alternatives affect CDQ owned catcher vessels, CDQ groups are likely to experience impact approximately equal to impacts felt by non-CDQ owners. The extent to which CDQ groups are expected to experience impacts on catcher vessels employment and payments to labor is unknown, because the level of CDQ group employment on CDQ owned catcher vessels is not known.

Compared to CDQ owned catcher vessels, CDQ groups are likely to experience proportionately less of the overall impacts on CDQ owned processors. However, since CDQ owned processing revenues (and presumably returns to owners) are of a much greater magnitude than revenues to CDQ owned catcher vessels, the effect of the Alternatives on CDQ processors is likely to be much more significant for CDQ groups. In addition to effects on group revenues, it is known that much of the employment of CDQ group members in the fishing and processing industry takes place on CDQ owned catcher processors—thus as employment and payments to labor of processing vessels are affected, CDQ groups will also be affected.

Several other issues regarding the CDQ Regions are noted in the following bullets:

- The CDQ Region is defined using the latest information on ownership by CDQ groups. This ownership information has been applied to activities in 1999, which has been used as the basis of all of the regional profiles. Thus even if a CDQ group finalized its purchase of a vessel in 2001, the activities of that vessel in 1999 are included in the CDQ region.
- All of the activities of the CDQ owned facilities were also included in the profiles of the geographic regions based on the owners listed in official registration data. Therefore, it would be inappropriate to add the CDQ Region impacts to impacts of the other regions.
- Because CDQ groups are generally part-owners of the vessels included in the CDQ Region profile, the actual impacts on CDQ groups are likely to be less than the total shown in the profile. It should also be noted that all of the regional profiles may similarly over- or understate the affects that may be experienced within the region. For example, since Alaska based CDQs groups have a significant ownership shares of vessels and processors that are primarily registered to residents of the WAIW region, it is likely that the impacts depicted in the WAIW region are somewhat overstated.
- Impacts to the CDQ region are different from impacts to other Alaska regions or the Pacific Northwest regions. In some respects, due to investment, ownership, and extra-regional employment

patterns, CDQ region impacts are more similar to WAIW region impacts than they are to impacts seen in other Alaska regions. In other respects, such as benefits derived from fishery associated state revenue sharing and indirect effects on subsistence, the impacts to the CDQ region are more like those seen in other Alaska regions than those anticipated for the WAIW region. In short, the CDQ region is unlike any other in the ways that impacts are likely to be felt in the region as a whole, or in individual communities.

Beyond these 21 socioeconomic indicators, Tables 4.12-57 through 4.12-63 present information relevant to CDQ specific impacts that is different from the type of information presented for the other regions. The impacts shown in these tables reflect the direct impacts of changes to the CDQ allocations under the alternatives. The following bullets describe each of the indicators shown.

- Estimates of CDQ Allocations are taken directly from analytical results provided by NMFS.
- Estimates of CDQ Allocation ex-vessel revenue represent the value of that portion of the CDQ Allocation that is expected to be delivered to shore plants or motherships and is an indicator of overall impacts of reduced CDQ quotas on catcher vessels. The expected proportion of deliveries to processors and ex-vessel prices are taken from activities in the base year (1999).
- Estimates CDQ Allocation wholesale revenue are the projected value of products from processors of CDQ quotas. Product forms, utilization rates, and product prices from CDQ fish are assumed no different than in the non-CDQ fisheries for the base year and are estimated from NMFS Blend and WPR data.
- CDQ Royalties are estimated from data on pollock royalties found in the CDQ Handbook (DCED, 2001) combined with estimated of wholesale revenues from NMFS Blend and WPR data. Data in the CDQ Handbook indicated the total royalties paid for CDQ pollock by year from 1992 through 2000. For the years 1998-2000, CDQ pollock royalties were estimated to have been approximately 38 percent of the estimated wholesale revenue. Therefore, the assessment of impacts under the alternatives assumed that royalties for pollock would be approximately 38 percent of expected wholesale revenue generated from CDQ pollock. Specific data on royalties for Pacific cod and Atka mackerel were not available, and therefore the analysis assumed that, like pollock, royalties from Pacific cod and Atka mackerel would be 38 percent of expected wholesale revenue generated from the CDQ allocations.
- CDQ Royalties per MT by species are estimated by dividing the expected total royalties by the expected CDQ allocations.

Alternative 1 - Baseline Conditions

The sixty-five coastal communities organized into six non-profit CDQ groups, total population of the communities in 2000 was estimated to be 27,073. although this population figure may include a substantial number of individuals who are not year-round residents. The CDQ program encompasses both groundfish and non-groundfish fisheries, with currently allocated portions ranging from 10 percent for pollock to 7.5 percent for most other species. The percentage of the total 2000 royalties generated by each non-pollock species are as follows: Pacific cod – 8%; opilio crab – 5%; Bristol Bay red king crab – 3%; and other species, including sablefish, Atka mackerel, halibut and turbot – 2%. After 1998, CDQ allocations became available for all groundfish species, and the harvest of some species such as Pacific cod (PCOD) and Atka mackerel

(AMCK) increased. The CDQ allocations recommended by the State for 2001-2002 represented approximately 185,00 metric tons of groundfish. Over the duration of the CDQ program, pollock CDQ royalties have consistently exceeded \$17 million. In 2000, the CDQ groups received over \$33 million in pollock CDQ royalties. Royalties from the multi-species program provided an additional \$7.5 million to the CDQ groups in 2000 (DCED 2001).

The program has provided more than 1,000 jobs annually for region residents with yearly wages exceeding \$8 million. This program has also contributed to infrastructure development projects within the region as well as loan programs and investment opportunities for local fishermen. The value of CDQ assets in aggregate increased from \$1.5 million in 1992 to over \$157 million in 2000 (DCED 2001). Increasingly, CDQ groups are using their CDQs to leverage capital investment in harvesting/processing capacity. All six CDQ groups have acquired ownership interests in the offshore pollock processing sector. In most of the processing ventures in which CDQ groups have invested, the groups are minority owners, however, the revenues derived from these investments may be substantial.

The groundfish processed by these enterprises accounted for about 14 percent of the total tonnage and 15 percent of the total wholesale value of groundfish processed in the Alaska fishery in 1999 and 2000. Overall, it is estimated that the ownership shares of CDQ groups represents approximately 27 percent of the total groundfish revenues of these enterprises based on a weighted average of wholesale product revenue. The groundfish harvested by these fishing operations accounted for about two percent of the total tonnage and three percent of the total ex-vessel value of groundfish harvested in the Alaska fishery in 1999 and 2000. Overall, it is estimated that the ownership shares of CDQ groups represents approximately 50 percent of the total groundfish revenues of these enterprises based on a weighted average of ex-vessel revenue.

With regard to the impacts to CDQ communities from the analysis of the following alternatives, because CDQ groups are generally part-owners of the vessels included in the CDQ region profiles actual impacts are anticipated to be less than the total outlined. Also, the CDQ region is defined using the latest available information regarding ownership by CDP groups, as such this information has been applied to activities in 1999 and utilised as the basis of all of the regional profiles.

Alternative 2

When compared, the high and low cases for Alternative 2 (Table 4.12.51) show the differences in the harvest of locally owned catcher vessels to be a total of 23 percent, with specifically 24 percent for pollock, 19 percent for Pacific cod and 13 percent for Atka mackerel. Since no shorebased processing facilities exist within CDQ communities, both the total ex-vessel value paid by shore based processors, and total shore based processing tons are not applicable.

Total harvesting and processing payments to labor differ by 12 percent, with 13 percent for pollock, 11 percent for Pacific cod, and 14 percent for Atka mackerel. Employment differences broadly mirror payments to labor with total differences of 13 percent, with 13 percent for pollock, 10 percent for Pacific cod, and 14 percent for Atka mackerel. Thus, as observed generally, uncertainty of the amount of fish to be harvested is much greater for Alternative 2 than for Alternative 4 or 1. For the CDQ communities the uncertainty under Alternative 2 associated with the pollock fishery is slightly greater than that for both the Pacific cod and Atka mackerel fisheries.

Projected differences for Alternative 2 from the baseline of Alternative 1 are best examined using Table 4.12-53. For the high-case of Alternative 2, total combined pollock, Pacific cod, and Atka mackerel harvested by

regionally owned catcher vessels declines by about 28 percent, specifically 27 percent for pollock, 45 percent for Pacific cod, and 67 percent for Atka mackerel.

Total Pacific cod, pollock, and Atka mackerel-related harvesting and processing payments to labor accruing to the region would change by similar amounts (20 percent in total, 19 percent for pollock, 25 percent for Pacific cod, and 67 percent for Atka mackerel). Employment levels almost exactly mirror payments to labor with a total decline of 19 percent, with specific declines of 19 percent for pollock, 23 percent for Pacific cod, and 67 percent for Atka mackerel.

For the low-case of Alternative 2, the results are more dramatic. The total combined pollock, Pacific cod, and Atka mackerel harvested by regionally owned catcher vessels would decline by 51 percent (51 percent for pollock, 64 percent for Pacific cod, and 80 percent for Atka mackerel). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change more significantly (32 percent in total, with 32 percent for pollock, 36 percent for Pacific cod, and 81 percent for Atka mackerel). Employment levels again almost exactly mirror payments to labor with a total decline of 32 percent, with specific declines of 31 percent for pollock, 33 percent for Pacific cod, and 81 percent for Atka mackerel.

In summary, depending on the socioeconomic variable chosen, Alternative 2 is projected to reduce CDQ community participation in the groundfish fishery by between 27 and 51 percent for pollock, between 21 and 64 percent for Pacific cod, between 67 and 81 percent for Atka mackerel or approximately 19 and 51 percent in total/when combined. Given the relative dependency upon the groundfish fishery in general, and the pollock and Pacific cod components of the fishery in particular, this would result in significant impacts to the CDQ groups/communities engaged in the fishery/fisheries.

In terms of other CDQ specific indices, for the high case of Alternative 2, CDQ allocations for the three relevant groundfish species combined would decline by 23 percent (including 19 percent for pollock, 44 percent for Pacific cod, and 67 percent for Atka mackerel). CDQ allocation ex-vessel revenue and wholesale revenue would decline by 19 percent and 21 percent, respectively. Overall CDQ royalties would decline by 21 percent. For the low case of Alternative 2, CDQ allocations for the three relevant groundfish species combined would decline by 43 percent (including 52 percent for pollock, 41 percent for Pacific cod, and 82 percent for Atka mackerel). CDQ allocation ex-vessel revenue and wholesale revenue would decline by 41 percent and 42 percent, respectively. Overall CDQ royalties would decline by 42 percent. These declines represent significant impacts.

Alternative 4

When compared, the high and low cases for Alternative 4 (Table 4.12.56) show the differences in the harvest of regionally owned catcher vessels to be a total of 4 percent, with 3 percent for pollock, 10 percent for Pacific cod and 8 percent for Atka mackerel. Since no shorebased processing facilities exist within CDQ communities, both the total ex-vessel value paid by shore based processors, and total shore based processing tons are not applicable.

The level of uncertainty introduced by Alternative 4 is thus increased over that of the baseline but is closer to "normal" risk than is that of Alternative 2. The Pacific cod fishery is more uncertain than is the pollock fishery. Projected differences for Alternative 4 from the baseline of Alternative 1 are best examined using Table 4.12-56. For the high-case of Alternative 4, total combined pollock and Pacific cod harvested by regionally owned catcher vessels does not decline in any statistically significant way. Specifically a total

decrease of 27 tons would be experienced (0.04%) of which 26 tons would be Pacific cod. Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region do not change by a statistically significant amount. Specifically a decrease in payments amounting to \$34,567 would be experienced (0.029 percent) of which \$34,715 would be attributable to a slightly smaller volume of cod being processed.

For the low-case of Alternative 4, total combined pollock, Pacific cod and Atka mackerel harvested by regionally owned catcher vessels declines by 4 percent (3 percent for pollock, 11 percent for cod, with a gain of 8 percent for Atka mackerel). Total Pacific cod, pollock, and Atka mackerel related harvesting and processing payments to labor accruing to the region change by broadly similar amounts - a decline of 3 percent in total, with specific declines of 3 percent for pollock and 4 percent for cod. An increase of 3 percent is anticipated for Atka mackerel. Employment levels again almost exactly mirror payments to labor with a total decline of 5 percent, with specific declines of 3 percent for pollock and 5 percent for Pacific cod, with an increase of 3 percent for Atka mackerel.

Thus, while Alternative 4 would have some effects upon CDQ communities participation in the fishery, for the most part such effects would be expected to be no worse than those experienced from "normal" fluctuations in the fishery.

In terms of other CDQ specific indices, for the high case of Alternative 4, CDQ allocations for the three relevant groundfish species combined would increase by 1 percent. CDQ allocation ex-vessel revenue would not change from the baseline and wholesale revenue would increase by 1 percent. Overall CDQ royalties would be unchanged. For the low case, CDQ allocations for the three relevant groundfish species combined would decrease by 6 percent. CDQ allocation ex-vessel revenue and wholesale revenue would decrease by 9 percent and 7 percent, respectively. Overall CDQ royalties would decline by 7 percent.

Table 4.12-50 Alternative 1- CDQ region groundfish socioeconomic indicators

Annual Summary Table	CDQ						High			Low		
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)	19	3,631	61,764	65,415	15	3,560	61,166	64,741	15	3,560	61,166	64,741
Total Ex-Vessel Value (\$)	1,466	2,416,367	15,130,289	17,548,121	1,149	2,371,440	14,983,539	17,356,128	1,149	2,371,440	14,983,539	17,356,128
Total Catcher Vessel Payments to Labor (\$)	586	966,547	6,052,115	7,019,248	460	948,576	5,993,416	6,942,451	460	948,576	5,993,416	6,942,451
Total CV Employment (FTE)	0	23	31	55	0	23	31	54	0	23	31	54
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	0	0	0	0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	431	18,944	370,099	389,475	325	18,438	364,654	383,416	325	18,438	364,654	383,416
Total Shore Based Processing in the Region (Round-Weight Tons)	0	0	0	0	0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	431	18,944	370,099	389,475	325	18,438	364,654	383,416	325	18,438	364,654	383,416
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	181,545	19,977,740	288,682,021	308,841,306	136,583	19,521,343	284,421,706	304,079,632	136,583	19,521,343	284,421,706	304,079,632
Total Shore Based Processed Value in the Region (\$)	0	0	0	0	0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	181,545	19,977,740	288,682,021	308,841,306	136,583	19,521,343	284,421,706	304,079,632	136,583	19,521,343	284,421,706	304,079,632
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	46,273	5,856,646	75,239,877	81,142,796	34,813	5,724,690	74,128,946	79,888,449	34,813	5,724,690	74,128,946	79,888,449
Total Shore Based Processing Payments to Labor in the Region (\$)	0	0	0	0	0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	18,154	1,997,774	28,868,202	30,884,131	13,658	1,952,134	28,442,171	30,407,963	13,658	1,952,134	28,442,171	30,407,963
Total Processing Payments to Labor Accruing to the Region (\$)	64,428	7,854,420	104,108,079	112,026,927	48,471	7,676,824	102,571,116	110,296,412	48,471	7,676,824	102,571,116	110,296,412
Total Regionally Owned At-Sea Processing Employment (FTE)	1	107	1,305	1,413	1	105	1,286	1,391	1	105	1,286	1,391
Total Shore Based Processing Employment in the Region (FTE)	0	0	0	0	0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	5	65	71	0	5	64	70	0	5	64	70
Total Processing Employment Accruing to the Region (FTE)	1	113	1,370	1,484	1	110	1,350	1,461	1	110	1,350	1,461
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	65,014	8,820,966	110,160,195	119,046,175	48,931	8,625,400	108,564,532	117,238,863	48,931	8,625,400	108,564,532	117,238,863
Total Harvesting and Processing Employment Accruing to the Region (FTE)	1	136	1,402	1,538	1	133	1,381	1,515	1	133	1,381	1,515

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-51 Alternative 2- CDQ region groundfish socioeconomic indicators

Annual Summary Table	CDQ				High				Low			
	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)	6	2,002	45,391	47,400	3	1,287	30,201	31,492				
Total Ex-Vessel Value (\$)	484	1,350,735	11,117,684	12,468,903	229	897,295	7,396,230	8,293,753				
Total Catcher Vessel Payments to Labor (\$)	194	540,294	4,447,074	4,987,561	91	358,918	2,958,492	3,317,501				
Total CV Employment (FTE)	0	15	23	38	0	13	15	28				
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)	0	0	0	0	0	0	0	0				
Total Regionally Owned At-Sea Processing (Round-Weight Tons)	142	13,921	300,470	314,533	61	11,742	252,665	264,468				
Total Shore Based Processing in the Region (Round-Weight Tons)	0	0	0	0	0	0	0	0				
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)	142	13,921	300,470	314,533	61	11,742	252,665	264,468				
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)	59,904	15,557,780	234,369,663	249,987,347	25,671	13,178,344	196,561,850	209,765,865				
Total Shore Based Processed Value in the Region (\$)	0	0	0	0	0	0	0	0				
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)	59,904	15,557,780	234,369,663	249,987,347	25,671	13,178,344	196,561,850	209,765,865				
Total Regionally Owned At-Sea Processing Payments to Labor (\$)	15,269	4,552,712	61,084,295	65,652,276	6,543	3,847,180	51,197,511	55,051,234				
Total Shore Based Processing Payments to Labor in the Region (\$)	0	0	0	0	0	0	0	0				
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)	5,990	1,555,778	23,436,966	24,998,735	2,567	1,317,834	19,656,185	20,976,587				
Total Processing Payments to Labor Accruing to the Region (\$)	21,259	6,108,490	84,521,262	90,651,011	9,110	5,165,014	70,853,696	76,027,821				
Total Regionally Owned At-Sea Processing Employment (FTE)	0	85	1,059	1,145	0	73	889	961				
Total Shore Based Processing Employment in the Region (FTE)	0	0	0	0	0	0	0	0				
Total Administrative Employment of All Regionally Owned Processors (FTE)	0	4	53	57	0	4	44	48				
Total Processing Employment Accruing to the Region (FTE)	0	89	1,112	1,202	0	76	933	1,009				
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)	21,453	6,648,784	88,968,335	95,638,572	9,202	5,523,933	73,812,188	79,345,322				
Total Harvesting and Processing Employment Accruing to the Region (FTE)	0	104	1,135	1,240	0	89	948	1,038				

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-52 Alternative 2- CDQ region groundfish socioeconomic indicators difference from Alternative 1 (baseline)

CDQ		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		- 13	-1,629	-16,374	-18,015	- 12	-2,273	-30,964	-33,250
Total Ex-Vessel Value (\$)		- 982	-1,065,632	-4,012,605	-5,079,218	- 921	-1,474,144	-7,587,310	-9,062,375
Total Catcher-Vessel Payments to Labor (\$)		- 393	-426,253	-1,605,042	-2,031,687	- 368	-589,658	-3,034,924	-3,624,950
Total CV Employment (FTE)		0	-8	-9	-17	0	-10	-16	-26
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		- 289	-5,023	-69,630	-74,942	- 264	-6,696	-111,988	-118,948
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		- 289	-5,023	-69,630	-74,942	- 264	-6,696	-111,988	-118,948
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		- 121,641	-4,419,961	-54,312,358	-58,853,959	- 110,912	-6,342,999	-87,859,857	-94,313,767
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		- 121,641	-4,419,961	-54,312,358	-58,853,959	- 110,912	-6,342,999	-87,859,857	-94,313,767
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		- 31,005	-1,303,934	-14,155,582	-15,490,520	- 28,270	-1,877,510	-22,931,435	-24,837,215
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		- 12,164	-441,996	-5,431,236	-5,885,396	- 11,091	-634,300	-8,785,986	-9,431,377
Total Processing Payments to Labor Accruing to the Region (\$)		- 43,169	-1,745,930	-19,586,817	-21,375,916	- 39,361	-2,511,810	-31,717,420	-34,268,591
Total Regionally Owned At-Sea Processing Employment (FTE)		- 1	-22	-245	-268	- 1	-33	-397	-430
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	-1	-12	-13	0	-2	-20	-21
Total Processing Employment Accruing to the Region (FTE)		- 1	-23	-258	-282	- 1	-34-417	-451	-451
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		- 43,561	-2,172,183	-21,191,859	-23,407,604	- 39,729	-3,101,468	-34,752,344	-37,893,541
Total Harvesting and Processing Employment Accruing to the Region (FTE)		- 1	-32	-266	-298	- 1	-44	-433	-478

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-53 Alternative 2- CDQ region groundfish socioeconomic indicators percentage difference from Alternative 1 (baseline)

CDQ		High Percentage Difference from Alternative 1 (Baseline)				Low Percentage Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		-67%	-45%	-27%	-28%	-80%	-64%	-51%	-51%
Total Ex-Vessel Value (\$)		-67%	-44%	-27%	-29%	-80%	-62%	-51%	-52%
Total Catcher Vessel Payments to Labor (\$)		-67%	-44%	-27%	-29%	-80%	-62%	-51%	-52%
Total CV Employment (FTE)		-67%	-36%	-27%	-31%	-75%	-43%	-51%	-48%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		-67%	-27%	-19%	-19%	-81%	-36%	-31%	-31%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		-67%	-27%	-19%	-19%	-81%	-36%	-31%	-31%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		-67%	-22%	-19%	-19%	-81%	-32%	-31%	-31%
Total Shore Based Processed Value in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		-67%	-22%	-19%	-19%	-81%	-32%	-31%	-31%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		-67%	-22%	-19%	-19%	-81%	-33%	-31%	-31%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		-67%	-22%	-19%	-19%	-81%	-32%	-31%	-31%
Total Processing Payments to Labor Accruing to the Region (\$)		-67%	-22%	-19%	-19%	-81%	-33%	-31%	-31%
Total Regionally Owned At-Sea Processing Employment (FTE)		-67%	-21%	-19%	-19%	-81%	-31%	-31%	-31%
Total Shore Based Processing Employment in the Region (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Employment of All Regionally Owned Processors (FTE)		-67%	-21%	-19%	-19%	-81%	-31%	-31%	-31%
Total Processing Employment Accruing to the Region (FTE)		-67%	-21%	-19%	-19%	-81%	-31%	-31%	-31%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		-67%	-25%	-19%	-20%	-81%	-36%	-32%	-32%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		-67%	-23%	-19%	-19%	-81%	-33%	-31%	-32%

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-54 Alternative 4- CDQ region groundfish socioeconomic indicators

CDQ		High				Low			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		19	3,605	61,763	65,388	17	3,153	59,059	62,229
Total Ex-Vessel Value (\$)		1,466	2,400,700	15,129,919	17,532,086	1,244	2,098,892	14,467,143	16,567,280
Total Catcher Vessel Payments to Labor (\$)		586	960,280	6,051,968	7,012,834	498	839,557	5,786,857	6,626,912
Total CV Employment (FTE)		0	24	31	56	0	20	30	50
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		431	19,100	370,099	389,630	334	17,883	356,048	374,265
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		431	19,100	370,099	389,630	334	17,883	356,048	374,265
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		181,545	20,108,331	288,682,021	308,971,897	140,413	18,863,265	277,365,042	296,368,721
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		181,545	20,108,331	288,682,021	308,971,897	140,413	18,863,265	277,365,042	296,368,721
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		46,273	5,884,568	75,239,877	81,170,719	35,789	5,526,352	72,266,306	77,828,447
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		18,154	2,010,833	28,868,202	30,897,190	14,041	1,886,327	27,736,504	29,636,872
Total Processing Payments to Labor Accruing to the Region (\$)		64,428	7,895,401	104,108,079	112,067,908	49,831	7,412,678	100,002,811	107,465,320
Total Regionally Owned At-Sea Processing Employment (FTE)		1	108	1,305	1,414	1	102	1,254	1,356
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	5	65	71	0	5	63	68
Total Processing Employment Accruing to the Region (FTE)		1	114	1,370	1,485	1	107	1,316	1,424
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		65,014	8,855,681	110,160,047	119,080,742	50,328	8,252,235	105,789,668	114,092,231
Total Harvesting and Processing Employment Accruing to the Region (FTE)		1	138	1,402	1,540	1	127	1,346	1,474

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-55 Alternative 4- CDQ region groundfish socioeconomic indicators difference from Alternative 1 (baseline)

CDQ		High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0	-26	-2	-27	1	-407	-2,106	-2,512
Total Ex-Vessel Value (\$)		0	-15,666	-369	-16,035	95	-272,547	-516,396	-788,848
Total Catcher Vessel Payments to Labor (\$)		0	-6,266	-148	-6,414	38	-109,019	-206,558	-315,539
Total CV Employment (FTE)		0	1	0	1	0	-3	-1	-4
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0	155	0	155	9	-555	-8,605	-9,151
Total Shore Based Processing in the Region (Round-Weight Tons)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0	155	0	155	9	-555	-8,605	-9,151
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0	130,591	0	130,591	3,830	-658,078	-7,056,664	-7,710,911
Total Shore Based Processed Value in the Region (\$)		0	0	0	0	0	0	0	0
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0	130,591	0	130,591	3,830	-658,078	-7,056,664	-7,710,911
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0	27,922	0	27,922	976	-198,338	-1,862,639	-2,060,001
Total Shore Based Processing Payments to Labor in the Region (\$)		0	0	0	0	0	0	0	0
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0	13,059	0	13,059	383	-65,808	-705,666	-771,091
Total Processing Payments to Labor Accruing to the Region (\$)		0	40,981	0	40,981	1,359	-264,146	-2,568,306	-2,831,092
Total Regionally Owned At-Sea Processing Employment (FTE)		0	1	0	1	0	-3	-32	-35
Total Shore Based Processing Employment in the Region (FTE)		0	0	0	0	0	0	0	0
Total Administrative Employment of All Regionally Owned Processors (FTE)		0	0	0	0	0	0	-2	-2
Total Processing Employment Accruing to the Region (FTE)		0	1	0	1	0	-3	-34	-37
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0	34,715	-148	34,567	1,397	-373,165	-2,774,864	-3,146,632
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0	2	0	2	0	-7	-35	-41

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-56 Alternative 4- CDQ region groundfish socioeconomic indicators percentage difference from Alternative 1 (baseline)

CDQ		High Percent from Alternative 1 (Baseline)				Low Percent from Alternative 1 (Baseline)			
Annual Summary Table		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
Total Regionally Owned CV Harvest (Tons)		0%	-1%	0%	0%	8%	-11%	-3%	-4%
Total Ex-Vessel Value (\$)		0%	-1%	0%	0%	8%	-11%	-3%	-5%
Total Catcher Vessel Payments to Labor (\$)		0%	-1%	0%	0%	8%	-11%	-3%	-5%
Total CV Employment (FTE)		0%	4%	0%	2%	5%	-13%	-4%	-8%
Total Ex-Vessel Value Paid by Shorebased Processors in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned At-Sea Processing (Round-Weight Tons)		0%	1%	0%	0%	3%	-3%	-2%	-2%
Total Shore Based Processing in the Region (Round-Weight Tons)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing--At-Sea or Shore Based (Round-Weight Tons)		0%	1%	0%	0%	3%	-3%	-2%	-2%
Total Regionally Owned At-Sea Processing At-Sea Processed Value (\$)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Shore Based Processed Value in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Regionally Owned Processing Value--At-Sea or Shore Based (\$)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Regionally Owned At-Sea Processing Payments to Labor (\$)		0%	0%	0%	0%	3%	-3%	-3%	-3%
Total Shore Based Processing Payments to Labor in the Region (\$)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Payments to Labor of All Regionally Owned Processors (\$)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Processing Payments to Labor Accruing to the Region (\$)		0%	1%	0%	0%	3%	-3%	-3%	-3%
Total Regionally Owned At-Sea Processing Employment (FTE)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Shore Based Processing Employment in the Region (FTE)		0%	0%	0%	0%	0%	0%	0%	0%
Total Administrative Employment of All Regionally Owned Processors (FTE)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Processing Employment Accruing to the Region (FTE)		0%	1%	0%	0%	3%	-3%	-2%	-3%
Total Harvesting and Processing Payments to Labor Accruing to the Region (\$)		0%	0%	0%	0%	3%	-4%	-3%	-3%
Total Harvesting and Processing Employment Accruing to the Region (FTE)		0%	2%	0%	0%	3%	-5%	-3%	-3%

Notes:

* Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

* Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-57 Alternative 1- CDQ allocations and royalties

CDQ	High					Low			
	CDQ Allocation Impacts	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
CDQ Allocation (MT)		5,198	17,928	140,000	163,126	4,013	17,883	137,480	159,376
CDQ Allocation Ex-vessel Revenue (\$) ^a		14,892	138,416	34,282,649	34,435,956	11,497	138,072	33,665,561	33,815,130
CDQ Allocation Wholesale Revenue (\$)		2,238,452	10,467,360	118,260,635	130,966,448	1,728,148	10,441,369	116,131,944	128,301,460
CDQ Royalties (\$) ^b		838,830	3,922,503	44,316,587	49,077,919	647,600	3,912,763	43,518,888	48,079,251
CDQ Royalties (\$/MT)		161.38	218.79	316.55	300.86	161.38	218.79	316.55	301.67

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-58 Alternative 2- CDQ allocations and royalties

CDQ	High					Low			
	CDQ Allocation Impacts	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
CDQ Allocation (MT)		1,716	10,125	113,659	125,500	738	8,535	81,386	90,658
CDQ Allocation Ex-vessel Revenue (\$) ^a		4,916	78,171	27,832,341	27,915,428	2,114	65,895	19,929,377	19,997,386
CDQ Allocation Wholesale Revenue (\$)		738,974	6,700,435	96,009,802	103,449,211	317,781	5,462,345	68,747,920	74,528,045
CDQ Royalties (\$) ^b		276,920	2,510,898	35,978,385	38,766,204	119,084	2,046,940	25,762,361	27,928,385
CDQ Royalties (\$/MT)		161.38	247.99	316.55	308.89	161.38	239.83	316.55	308.06

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-59 Alternative 2- CDQ allocations and royalties difference from Alternative 1 (baseline)

Table 11.2 CDQ allocations and royalties under Alternative 1 (Baseline)									
CDQ	CDQ Allocation Impacts	High Difference from Alternative 1 (Baseline)				Low Difference from Alternative 1 (Baseline)			
		Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
CDQ Allocation (MT)		- 3,482	-7,803	-26,341	-37,626	- 3,275	-9,348	-56,094	-68,718
CDQ Allocation Ex-vessel Revenue (\$) ^a		- 9,976	-60,245	-6,450,308	-6,520,528	- 9,383	-72,177	-13,736,184	-13,817,744
CDQ Allocation Wholesale Revenue (\$)		- 1,499,479	-3,766,925	-22,250,833	-27,517,237	- 1,410,367	-4,979,024	-47,384,024	-53,773,415
CDQ Royalties (\$) ^b		- 561,910	-1,411,604	-8,338,201	-10,311,715	- 528,516	-1,865,822	-17,756,527	-20,150,866
CDQ Royalties (\$/MT)		0.00	29.20	0.00	8.04	0.00	21.04	0.00	6.39

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-60 Alternative 2- CDQ allocations and royalties percentage difference from Alternative 1 (baseline)

CDQ	High Percentage Difference from Alternative 1 (Baseline)					Low Percentage Difference from Alternative 1 (Baseline)					
	CDQ Allocation Impacts			Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
CDQ Allocation (MT)				-67%	-44%	-19%	-23%	-82%	-52%	-41%	-43%
CDQ Allocation Ex-vessel Revenue (\$) ^a				-67%	-44%	-19%	-19%	-82%	-52%	-41%	-41%
CDQ Allocation Wholesale Revenue (\$)				-67%	-36%	-19%	-21%	-82%	-48%	-41%	-42%
CDQ Royalties (\$) ^b				-67%	-36%	-19%	-21%	-82%	-48%	-41%	-42%
CDQ Royalties (\$/MT)				0%	13%	0%	3%	0%	10%	0%	2%

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-61 Alternative 4- CDQ allocations and royalties

CDQ	High					Low			
	CDQ Allocation Impacts								
CDQ Allocation (MT)	Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total	
	5,198	19,628	140,000	164,826	4,465	19,291	125,664	149,420	
CDQ Allocation Ex-vessel Revenue (\$) ^a	14,892	151,542	34,282,649	34,449,083	12,792	148,938	30,772,105	30,933,836	
CDQ Allocation Wholesale Revenue (\$)	2,238,452	11,460,016	118,260,635	131,959,104	1,922,843	11,263,107	106,150,746	119,336,696	
CDQ Royalties (\$) ^b	838,830	4,294,487	44,316,587	49,449,904	720,560	4,220,698	39,778,568	44,719,826	
CDQ Royalties (\$/MT)	161.38	218.79	316.55	300.01	161.38	218.79	316.55	299.29	

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-62 Alternative 4- CDQ allocations and royalties difference from Alternative 1 (baseline)

CDQ	High Difference from Alternative 1 (Baseline)					Low Difference from Alternative 1 (Baseline)				
	CDQ Allocation Impacts									
	Atka	Pacific cod	Pollock	Total		Atka	Pacific cod	Pollock	Total	
CDQ Allocation (MT)	0	1,700	0	1,700		452	1,407	-11,816	-9,956	
CDQ Allocation Ex-vessel Revenue (\$) ^a	0	13,126	0	13,126		1,295	10,866	-2,893,456	-2,881,294	
CDQ Allocation Wholesale Revenue (\$)	0	992,656	0	992,656		194,695	821,738	-9,981,198	-8,964,764	
CDQ Royalties (\$) ^b	0	371,984	0	371,984		72,959	307,935	-3,740,320	-3,359,425	
CDQ Royalties (\$/MT)	0.00	0.00	0.00	-0.85		0.0	0.0	0.0	-2.4	

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

Table 4.12-63 Alternative 4- CDQ allocations and royalties percentage difference from Alternative 1 (baseline)

CDQ	High Percent from Alternative 1 (Baseline)				Low Percent from Alternative 1 (Baseline)							
	CDQ Allocation Impacts				Atka	Pacific cod	Pollock	Total	Atka	Pacific cod	Pollock	Total
CDQ Allocation (MT)					0%	9%	0%	1%	11%	8%	-9%	-6%
CDQ Allocation Ex-vessel Revenue (\$) ^a					0%	9%	0%	0%	11%	8%	-9%	-9%
CDQ Allocation Wholesale Revenue (\$)					0%	9%	0%	1%	11%	8%	-9%	-7%
CDQ Royalties (\$) ^b					0%	9%	0%	1%	11%	8%	-9%	-7%
CDQ Royalties (\$/MT)					0%	0%	0%	0%	0%	0%	0%	-1%

Notes:

^a Ex-vessel revenues represent the delivered value of that portion of the CDQ allocations that are harvested by catcher vessels based on 1999 catch data.

^b Royalty are estimates assumed to be 38 percent of wholesale value, which corresponds to the weighted average of royalties for pollock from 1998 through 2000--royalty data specific to Atka mackerel and Pacific cod were not available.

4.12.2.3 Environmental Justice Effects

This discussion in this section is organized into six different topical areas as outlined below. This discussion organization reflects the complexity of the environmental justice issue for the North Pacific Groundfish fishery, the range of regions and communities that may experience impacts, and the complex nature of ties of specific regions and communities to different sectors of the fishery, all of which have implications for environmental justice outcomes. Each topic is discussed in turn, and includes conclusions by region and alternative, consistent with other social impact analysis sections. The individual topics are:

- Community level environmental justice impacts
- Catcher vessel fleet related environmental justice impacts
- Catcher-processor fleet related environmental justice impacts
- Shore processor related environmental justice impacts
- CDQ related environmental justice impacts
- Subsistence related environmental justice impacts

Groundfish Community Level Environmental Justice Impacts

For the Alaska Peninsula/Aleutian Islands region, as noted in Section 4.12.2.2.1, Alternative 2 is projected to reduce participation in pollock and Pacific cod fisheries by 32 to 60 percent, depending on the socioeconomic indicator chosen. Given the relative dependency upon the pollock and Pacific cod components of the fishery, this would result in significant and profound impacts to those communities in the region most engaged in the fishery - Unalaska, Akutan, King Cove, and Sand Point. Beyond impacts to the fisheries related sector of the economy, impacts would ripple through other sectors of the local economy. The degree to which other sectors would decline depends upon the relative level of integration of the processing and harvesting sectors with the rest of the community economy and the diversity within the fisheries specific portion of the economy (these factors are discussed in detail in Appendix F(1)). Unalaska, with its substantial support service sector, would experience additional impacts. Fisheries related local government revenues would also decline significantly, with the specific amount depending on the local tax structure. Given that King Cove and Sand Point are communities where Alaska Natives constitute a plurality, these high and adverse impacts are an environmental justice issue, as they would disproportionately accrue to a minority population. Akutan, with its unique dual traditional community/large groundfish plant industrial enclave structure, plus its CDQ engagement, as described in Appendix F(1), would also likely experience environmental justice impacts, but the local fishery support sectors are relatively undeveloped compared to the other regional groundfish communities. Other predominately Alaska Native communities of the Aleutians East Borough would experience a substantial decline in groundfish related tax revenue as a result of Alternative 2, and economic opportunities are generally limited in these communities. Alternative 4 is not anticipated to have high and adverse impacts in the communities of this region.

For the Kodiak region, commercial groundfish activity is highly concentrated in the City of Kodiak itself, a largely non-Native community. All regional groundfish processors, except one, are located there, as are 87 percent of the regionally owned catcher vessels that, in turn, account for fully 95 percent of the total ex-vessel value of the regionally owned fleet over the period from 1992 to 2000. As noted in Section 4.12.2.2.2, Alternative 2 is projected to reduce Kodiak participation in the groundfish fishery by about 41 to 82 percent for pollock and Pacific cod combined, depending on the socioeconomic variable chosen. This would have significant socioeconomic effects upon the region, and especially the community of Kodiak, given the local engagement in, and dependency upon the groundfish fishery. The City of Kodiak's population is a non-minority plurality, and the Alaska Native population component is relatively small (less than 11 percent). It is not considered likely, therefore, that these would be environmental justice impacts, at least on the community level. Alternative 4 is not anticipated to result in high and adverse impacts to this region.

For the Southcentral and Southeast Alaska regions, the Washington inland waters region, and the Oregon coast region, neither Alternative 2 or Alternative 4 is anticipated to result in high and adverse impacts at the community level. Therefore, neither alternative is considered likely produce environmental justice concerns in these regions.

Catcher Vessel Fleet Related Environmental Justice Impacts

Resident owners and crew of the catcher vessel fleet in the Alaska Peninsula/Aleutian Islands region are assumed to be representative of the overall population of their communities. Given that assumption, the previously described significant impacts to regional catcher vessels resulting from Alternative 2 are considered to be high and adverse, and would disproportionately accrue to a minority (Alaska Native) population in the region, particularly in the communities of King Cove and Sand Point. These communities together accounted for 72 percent of all regionally owned groundfish vessels and 83 percent of the total regionally owned ex-vessel groundfish value over the 1992-2000 period. Some disproportionate impacts would also be likely in Unalaska/Dutch Harbor, where the local fleet accounted for 21 percent of all regionally owned groundfish vessels and 14 percent of the total regionally owned ex-vessel value during this same time span. It is not as clear, however, that this would be an environmental justice issue, given the overall demography of the community (less than 8 percent Alaska Native in 2000), despite the fact that Alaska Native residents may be more likely to be engaged in the catcher vessel sector of the fishery than is the general population due to length of residence and historical engagement in fishery activity in general, among other factors. (As noted in Section 1.4 of Appendix F(1), catcher vessels from the Chignik/Peninsula area communities of Chignik Bay, Chignik Lagoon, Chignik Lake, Ivanof Bay, and/or Perryville have participated in the commercial groundfish fishery at higher levels in 1997 and later years compared to earlier years, and impacts to this fleet may be environmental justice issues, but data on the fleet are sparse.) High and adverse impacts are not anticipated to result from Alternative 4, and therefore environmental justice is not an issue for vessel owners and crews in this region under that alternative.

Vessel owners and crew in the Kodiak region will experience significant impacts under Alternative 2 similar to those seen for the Alaska Peninsula/Aleutian Islands region, but this is not likely to be an environmental justice issue, given the relatively small proportion of Alaska Natives in the overall community population. However, as was in the case of Unalaska/Dutch Harbor, Kodiak region Alaska Native residents may be more likely to be engaged in the catcher vessel sector of the fishery than is the general population, due to length of residence and historical engagement in fishery activity, among other factors. High and adverse impacts are not anticipated to result from Alternative 4, and therefore environmental justice is not an issue for vessel owners and crews in this region under that alternative.

For catcher vessel owners and crew in the Southcentral and Southeast Alaska regions, direct impacts resulting from Alternatives 2 or 4 are noted in earlier sections as not likely to be significant. There are no indications that the impacts that would occur and potentially accrue to minority populations or low-income populations would be high and adverse. Available data does not permit a determination of the minority status of vessel owners and crew from the Washington inland waters or Oregon coast regions, nor is disproportionate minority representation assumed to exist.

Catcher-Processor Related Environmental Justice Impacts

As discussed in Section 3.12.2.10 and Appendix F(1), the workforce populations associated with the catcher-processor sector are largely associated with the Washington inland waters region in general, and the greater Seattle area in particular, where majority ownership of this sector is concentrated. (While individuals recruited from and through Washington dominate employment in this overall sector, some of the smaller entities within this sector are based in the Kodiak region, and Alaska hire in general, and Alaska Native hire specifically, has been the focus of targeted hiring efforts in the sector as a whole for a number of years.) The workforce population of this sector is significantly different demographically from the overall population of the greater Seattle area, based on 2000 U.S. Census data for the community and on industry self-reported information for the same year. While the greater Seattle area is 23 percent minority, this workforce is 63 percent minority, according to industry data. The minority component of the various entity workforces within this sector were largely comprised of individuals of Hispanic or Asian ancestry. Industry provided data indicate that in 2000, individual reporting entities were anywhere from about 36 percent to about 86 percent minority. Therefore, the estimated 800 to 1,200 jobs (FTE's) lost to the total regionally owned at-sea processing employment under Alternative 2 (Table 4.12-24) would largely be jobs lost by minority workers. This would be a high and adverse impact disproportionately accruing to a minority population, and therefore is an environmental justice impact. Alternative 4 is not anticipated to have high and adverse impacts to this sector in this region.

For the Alaska Peninsula/Aleutian Islands, Kodiak, Southcentral and Southeast Alaska regions, neither Alternative 2 nor Alternative 4 are anticipated to result in high and adverse employment impacts to catcher-processors. Additionally, no Alaska groundfish catcher-processors are based in the Oregon coast region. Therefore, environmental justice is not considered an issue for this sector in these regions. Employment from the CDQ region associated with the catcher-processor sector would decline under Alternative 2 and is a potential environmental justice issue, as discussed in Section 4.12.2.2.7.

Shore Processor Related Environmental Justice Impacts

As discussed in Section 3.12.2.10, the workforce populations associated with the shore based processing plants in the Alaska Peninsula/Aleutian Islands region are significantly different demographically from the overall populations of these communities, based on both on interpretation of U.S. Census data and on more recent industry self-reported information. These workforces are largely comprised of minority workers, primarily of either Asian or Hispanic ancestry. Industry provided data indicate that in 2000, 79 percent of the workers at the plants are minority individuals, and that individual reporting plants were anywhere from about three-quarters to over 90 percent minority. While a complete sample of processors was not obtained, it is assumed for the purposes of this analysis (and this assumption is based, in part, on previous knowledge of the industry) that the large processors in the region are at least roughly equivalent in their workforce composition, at least with respect to the general proportion of minority hires, if not in the specific combination of minority groups represented at each entity. Therefore, the estimated 1,200 to 2,200 jobs (FTE's) lost to the total shore based processing employment in the region under Alternative 2 (Table 4.12-12) would overwhelmingly be jobs lost by minority workers. This would be a high and adverse impact disproportionately accruing to a minority population, and therefore is an environmental justice impact. These impacts would be further accentuated by the fact that, as noted in Section 3.12.2.10, at least some of these workers have limited English language skills and this, combined with limited opportunity to acquire job skills in other economic sectors, would tend to indicate that these minority workers would be less able to easily acquire alternative employment outside of the seafood industry than average American workers. Alternative 4 is not anticipated to have high and adverse impacts to this sector in the Alaska Peninsula/Aleutian Islands region.

For the Kodiak region, shorebased groundfish processing employment under Alternative 2 is expected to decline by approximately 240 to 340 jobs (FTE's) (Table 4.12-15). Although relatively small in comparison to the job losses anticipated for the Alaska Peninsula/Aleutian Islands region, this is a very substantial proportion (about 50 to 70 percent) of total Pacific cod, pollock, and Atka mackerel groundfish shore processing employment in the Kodiak region. Industry provided data, though incomplete, suggest that these jobs are overwhelmingly held by minority workers. If this pattern holds true, this would be a high and adverse impact, accruing disproportionately to a minority population, and would therefore be an environmental justice impact. Alternative 4 is not anticipated to result in high and adverse impacts to this sector in this region.

For the Southcentral and Southeast Alaska regions, neither Alternative 2 nor Alternative 4 are anticipated to result in high and adverse employment impacts to shore based processors. Additionally, no Alaska groundfish shore based processors are located in the Washington inland waters or Oregon coast regions. Therefore, environmental justice is not considered an issue for this sector in these regions.

CDQ Related Environmental Justice Impacts

CDQ impacts under Alternative 2, as described in Section 4.12.2.2.7, will result in disproportionate high and adverse impacts to the predominately Alaska Native CDQ region communities. As noted in Appendix F(4), the Alaska Native population component represents 87 percent of the total population of the communities of this region. Further, as recognized by the very initiation of the CDQ program, the region is economically underdeveloped and employment and income alternatives are few. CDQ impacts would be felt in a number of different ways, including employment, income, revenues, royalties, and return on fishery investments, as described in Section 4.12.2.2.7. Impacts deriving from Alternative 4 are not likely to be high and adverse or disproportionately felt in the CDQ region.

Subsistence Related Environmental Justice Impacts

Potential subsistence impacts are described in Appendix F(3). Subsistence impacts in general are an environmental justice issue due to the disproportionate involvement of Alaska Natives in subsistence pursuits (and the exclusive engagement of Alaska Natives in subsistence activities involving taking of marine mammals). As noted in the Appendix F(3) analysis, no direct negative impacts on groundfish subsistence utilization or Steller sea lion subsistence utilization are anticipated for any of the alternatives. Indirect impacts as a result of lost opportunities for joint commercial and subsistence production are possible, however, and would most likely be experienced in King Cove, Sand Point, and Kodiak under Alternative 2 for reasons detailed in Appendix F(3). Given the assumption that the King Cove and Sand Point catcher vessel fleets are reflective of the overall demographic structures of those communities, and given that those communities have a plurality of Alaska Native residents, to the degree that joint production impacts are felt, they would likely be environmental justice impacts. For Kodiak, the white or non-minority residents represent a plurality, and the Alaska Native component of the population only accounts for 10 percent of the total population. Therefore, subsistence impacts in this community are not likely to be a high and adverse environmental justice issue. Indirect subsistence impacts resulting from a loss of commercial fisheries income are also likely under Alternative 2, but these impacts may be felt in a much wider range of communities, and are not possible to quantify with existing data. Subsistence impacts under Alternative 4 are not likely to be significant.

High and adverse impacts to subsistence are not considered likely for either the Southcentral or Southeast Alaska regions under either Alternative 2 or Alternative 4. Subsistence impacts are not applicable to the Washington inland waters region or the Oregon coast region. Therefore, impacts to subsistence is not an environmental justice issue in any of these four regions.

4.13 Cumulative Effects

Introduction

A cumulative effects analysis is a requirement of the National Environmental Policy Act (NEPA). An environmental assessment or environmental impact statement must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) guidelines for evaluating cumulative effects state that "...the most devastating environmental effects may result not from the direct effects of a particular action but from the combination of individually minor effects of multiple actions over time." (CEQ 1997).

The CEQ regulations for implementing NEPA define cumulative effects as:

"the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Cumulative effects are linked to incremental actions or policy changes that individually may have small outcomes, but that in the aggregate and in combination with other factors can result in greater effects in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) ecosystems. At the same time, the CEQ guidelines recognize that it is not practical to analyze the cumulative effects of an action on the universe but to focus on those effects that are truly meaningful.

This section analyzes the potential direct and indirect effects of Steller sea lion protection alternatives with other factors that affect physical, biological, and socioeconomic resource components of the BSAI and GOA environment. Peer reviewed literature and quantitative research on the cumulative effects of fishing activities in the Bering Sea and Gulf of Alaska are limited. The following cumulative effects analysis addresses the potential magnitude of effects and is somewhat qualitative in nature.

Methodology and External Factors

The intent of the cumulative effects analysis is to capture the total effects of many actions over time that would be missed by evaluating each action individually. A cumulative effects assessment describes the additive and synergistic result of the actions proposed in this SEIS as they interact with factors external those proposed actions. To avoid the piecemeal assessment of environmental impacts, cumulative effects were included in the 1978 CEQ regulations, which led to the development of the CEQs cumulative effects handbook (CEQ 1997) and federal agency guidelines based on that handbook (e.g., EPA 1999). Although predictions of direct effects of individual proposed actions tend to be more certain, cumulative effects may have more important consequences over the long term. The possibility of these "hidden" consequences presents a risk to decision makers, because the ultimate ramifications of an individual decision might not be obvious. The goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of alternative management actions. This section characterizes the incremental cumulative effects that potentially arise from external factors in combination with the direct and indirect effects.

Methodology

The methodology for cumulative effects analysis in this SEIS is similar to that followed in the Alaska Groundfish Draft Programmatic SEIS (NMFS 2001a), and is described in greater detail in section 4.13.1 and 4.13.2 of that document. It consists of the following steps:

- *Identify characteristics and trends within the affected environment that are relevant to assessing cumulative effects of the action alternatives* - this information is presented in each of the cumulative effects sections, along with additional supporting information in relevant sections of both Chapter 3.0 of this SEIS and the Groundfish Draft Programmatic SEIS.
- *Describe the potential direct and indirect effects of each of the five alternatives* - this information is presented in detail in section 4.1 through 4.12 of this SEIS, and is summarized in the cumulative effects ranking tables. The cumulative effects analysis uses the specific direct and indirect effects that have been evaluated for comparison with external factors
- *Identify past, present and reasonably foreseeable external factors such as other fisheries, other types of human activities, and natural phenomena that could have additive or synergistic effects* - Past actions must be evaluated to determine whether there are lingering effects that may still result in synergistic or incremental impacts when combined with the proposed action alternatives. The CEQ guidelines require that cumulative effects analysis assess reasonably foreseeable future actions. Because analysis of relevant past present and future effects depends on the resource or characteristic being evaluated, the time period for looking at past and reasonably future effects will vary. Pertinent external factors used to evaluate potential effects are described further in this introduction;
- *Use cumulative effects tables to screen all of the direct/indirect effects with external factors to capture those synergistic and incremental effects that are potentially cumulative in nature* - both adverse and beneficial effects of external factors on the criteria used for direct and indirect effects are assessed, and then evaluated in combination with the direct and indirect effects to determine if there are cumulative effects;
- *Evaluate the significance of the potential cumulative effects using criteria established for direct and indirect effects and the relative contribution of the action alternatives to cumulative effects* - Of particular concern are situations where insignificant direct and indirect effects lead to significant cumulative effects or where significant external effects accentuate significant direct and indirect effects; and
- *Discuss the reasoning that led to the evaluation of significance, citing evidence from the peer-reviewed literature and quantitative information where available* - as with direct and indirect effects, the term conditional significance has been used where conclusions of significance are based on reasoned assumptions, and the term unknown is used where there is not enough information to reach a conclusion of significance.

The advantages of this approach are that it (1) closely follows CEQ guidance, (2) employs an orderly and explicit procedure, and (3) provides the reader with the information necessary to make an informed and independent judgment concerning the validity of the conclusions.

External Factors and Effects

A cumulative effects analysis takes into account the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). For the purposes of this SEIS, the definition of other actions includes both human controlled events such as other fisheries, pollution and industrial development, and natural events such as disease, winter mortality, and short and long term climate change.

In order to ascertain the importance of the external impacts in the cumulative case, a comprehensive checklist was produced for each resource category (marine mammals, seabirds, target species, non-target species, prohibited catch species, habitat, socioeconomic characteristics, and ecosystem). Within each resource checklist the effects were divided into the two main categories (1) human controlled events and (2) natural events. Due to inherent differences from biological resources and systems, external effects impacting the socioeconomic category were developed to consider different events and topics.

Information presented in the checklists was obtained from reviewing environmental impact statements, reports and resource studies, and peer-reviewed literature, and was used as a tool in conjunction with information obtained from expert contributors to determine the beneficial (+), adverse (-), or neutral (0) effects ratings utilized in the tables.

Human Controlled Events

The detailed checklists address the following external actions which could be considered human controlled:

- *Effects from other fisheries* - Direct catch, bycatch, and direct and indirect mortality from foreign, joint venture (JV), State of Alaska and international halibut fisheries,
- *Effects from commercial hunting and harvesting* - approved commercial marine mammals and subsistence harvests.
- *Anthropogenic effects* - pollution, oil and gas activities, logging, creation of infrastructure (ports and harbors), commercial shipping effects, harassment, and introduced mammals (specifically applicable to seabirds).

Historical Fisheries (Foreign Joint Venture, and Domestic): Other fisheries considered in this cumulative effects analysis include foreign fisheries both today and in the past, and past JV fisheries. In addition to the brief summary provided below, Section 2.7.2 of the Groundfish Draft Programmatic SEIS provides a detailed discussion of the evolution of the fisheries management plans in use today and includes descriptions of the historical foreign, and JV fisheries. Figure 2.7-6 in the Draft Programmatic SEIS shows changes in the balance of domestic, JV, and foreign harvests over time.

A very robust foreign groundfish fishery operated off Alaska long before the Magnuson-Stevens Act was passed in April 1976. The United States had little leverage to restrict the large offshore Japanese and Soviet operations during their initial build-up. U.S.-foreign bilateral agreements were the main mechanism for managing the foreign fisheries. By 1972-1973, foreign operations had spread from Alaska south to the Pacific Coast off Washington and Oregon, leaving very depressed stocks in their wake off Alaska. Catches of yellowfin sole in the eastern Bering Sea, for example, had fallen sharply following very large removals by Japan and the Soviet Union. Pacific ocean perch stocks in the GOA were decimated. Pollock catches were increasing rapidly and were thought likely to follow the same pattern as perch and flatfish. When the

Magnuson-Stevens Act was passed in 1976, groundfish fisheries were, for all practical purposes, totally foreign. Most measures were designed to lessen their impact on domestic fisheries for halibut and crab. U.S. commercial fisheries were limited mainly to red king crab in the GOA and eastern Bering Sea, herring in coastal waters, salmon, and halibut. Very little groundfish, other than sablefish and small amounts of Pacific cod off southeast Alaska, were taken by the domestic fleet.

By the end of 1985, only minor foreign fisheries, directed on pollock and Pacific cod, were being allowed in the GOA. Foreign harvesting continued in the Bering Sea. Even there, foreign trawling had ended within 20 nautical miles (nm) of the Aleutian Islands, and foreign longlining for cod was restricted to north of 55°N and west of 170°W, depending on ice conditions. Foreign harvests dropped to less than 1 million mt in 1985. In contrast, U.S.- foreign JVs had grown rapidly through the early 1980s. They harvested about 880,000 mt in 1985, using over 100 U.S. trawlers working within some 28 different company arrangements with such countries as Japan, South Korea, Poland, the Soviet Union, Portugal, and Iceland. Completely domestic annual processing (DAP) reached 105,000 mt in 1985, mostly by trawler catcher/processors (a.k.a. factory trawlers).

During the five year period between 1986–1991, the groundfish fisheries became totally domestic. The last years of foreign directed fishing in the GOA and BSAI were 1986 and 1987, respectively. Foreign JV peaked in 1987, and their last years of operation in the Gulf of Alaska and the Bering Sea were 1988 and 1991, respectively.

Current Foreign Fisheries (outside the Exclusive Economic Zone): Agreement between Japan, People's Republic of China, Republic of Korea, Republic of Poland, Russian Federation, and the United States that provides a management structure for the pollock fishery in the central Bering Sea. The Convention was initiated due to concern over the unregulated pollock fishery occurring in the central Bering Sea ("Donut Hole") during the mid- to-late 1980s.

The transboundary nature of pollock in the Bering Sea increases the stock's vulnerability to overfishing. Currently the condition of pollock within the western Bering Sea is difficult to determine due to differences in survey approaches. If significant harvest of juvenile pollock that will recruit to the eastern Bering Sea population occurs in the Russian Exclusive Economic Zone (EEZ) there could be a reduction in the exploitable biomass and yield in the U.S. EEZ. Management decisions made on poor knowledge of the pollock stock could be disastrous for the U.S. and Russian fisheries.¹

High Seas Drift Net Fisheries: The world community did not consider high seas driftnetting a sustainable fishery. High bycatch, discards, and spoiled catch were associated with high seas driftnetting. United Nations General Assembly Resolution 46/214 banned large-scale high seas drift net fishing beginning in 1993. Nations of the world have for the most part complied with this non-binding resolution. With the exception of a few rogue vessels, this type of fishing is no longer conducted. The U.S. Coast Guard and Canadian Maritime Forces patrol the North Pacific to detect any possible illegal driftnet activity. (Source: <http://russia.shaps.hawaii.edu/fishing/>)

State of Alaska Fisheries: A summary of the scope of State of Alaska managed fisheries in the Bering Sea and Gulf of Alaska was provided in Chapter 4. Although not managed by the state, the International Pacific Halibut Commission (IPHC) fishery is included on this table.

¹C. Pautzke, "Personal Communication," North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252.

Commercial and Subsistence Hunting and Harvesting (Marine Mammals): Hunting has had a major impact on populations of marine mammals in both the Bering Sea and GOA (NRC 1996). Over the past 200 years, nearly all species have been harvested for commercial and subsistence purposes. Grey whales, bowhead whales, fur seals, walruses, and sea otters have been severely reduced, but their populations are recovering. Species of relatively low commercial value such as Steller sea lions, and several species of seals including harbor seals were not severely depleted by hunting, but have been consistently hunted for their subsistence use.

Native Subsistence Fisheries and Harvests: These fisheries have traditionally focused on near-shore species such as salmon, herring, shellfish (molluscan and crustacean), and a few demersal or groundfish species such as cod, halibut, and rockfish. These subsistence fisheries account for small amounts of fish relative to the commercial fisheries, and they continue in the present time.

Other Anthropogenic Effects: Of the anthropogenic effects listed above, pollution, harassment, and introduced mammals were determined to be not significant at the level of population effects for all resource categories (NRC 1996). Oil and gas leasing activities on the outer continental shelf of the GOA and BSAI were considered but are not incorporated into the analysis because such leasing is unlikely in the reasonably foreseeable future. Depending on the resource category, logging, creation of infrastructure (ports and harbors), and commercial shipping effects are considered in the Tier 2 matrices.

Natural Events

Natural events or phenomena considered in the checklists included:

- *Climate effects* – long and short term remotely forced sea surface temperature anomalies, and interdecadal climactic changes (regime shift);
- *Life cycle effects* – winter mortality and disease; and
- *Trophic interactions* – predation, competition and changes in community structure.

Climate Effects: Atmospheric forced sea surface temperature impacts include two principal modes of remotely forced sea surface temperature anomalies: shorter term El Niño/Southern Oscillation (ENSO) events and longer term Pacific decadal oscillations (PDO) (Mantua et al. 1997). These anomalies and their associated environmental changes are discussed in detail in Section 3.1.9 of the Groundfish Draft Programmatic SEIS.

The regime shift of 1976/1977 is now widely recognized, as well as its associated far reaching consequences for the large marine ecosystems of the North Pacific. The 50–70 year interdecadal variability (a two-regime cycle) has been prevalent from the eighteenth century to the present in North America and the likely cause is essentially an internal oscillation in the coupled atmosphere-ocean system. This suggests that the next climatic regime shift is most likely to occur in the coming decade between 2000 and 2007. Long-term changes in fish populations around the North Pacific have apparently been influenced by climatic change of the same 50–70 year variability. Section 3.1.7 of the Groundfish Draft Programmatic SEIS describes the regime changes and associated environmental impacts.

In many cases, the effects of climate shifts are scored as a “+/-” on the cumulative effects tables. This score indicates that the climate shift could have positive or negative effects depending on the direction of the shift (colder or warmer water) and the species or group under consideration.

Life Cycle Effects: Disease was determined to be not significant at the level of population effects for all resource categories (NRC 1996), and therefore is not included on the cumulative effects tables. In almost all cases, the effects of winter mortality of the species or group in a given resource category is unknown. This effect is also not included in the tables.

Trophic Interactions: Where information was available, these interactions and how they shape community structure are included in the checklists. The effects are brought forward to the cumulative effects tables only in cases where an indirect cause/effect relationship could be established for a given resource category.

4.13.1 Marine Mammals

Marine mammals species or species groups in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) considered in this analysis include pinnipeds, toothed whales, baleen whales, and sea otters. These categories are discussed individually in Section 3.1 and Section 4.1 of this document. A detailed discussion of the approach used for the cumulative effect analyses presented in this section is presented in Section 4.13 of the Groundfish Draft Programmatic SEIS.

4.13.1.1 Summary of Affected Environment Factors

Though the intent of the alternative management schemes presented are to mitigate potential impacts of the BSAI/GOA commercial groundfish fisheries on Steller sea lions, the effects of the alternatives must be evaluated for all marine mammals that may directly or indirectly interact with this fisheries within the action area. As stated in the Groundfish Draft Programmatic SEIS, this analytical approach allows for direct comparison of effects among multiple groups of marine mammals, each with varying levels of interaction with the fisheries.

The marine mammals or marine mammal groups which were screened for the cumulative effects analysis include: Steller sea lion, other ESA listed whales, other cetaceans, northern fur seal, harbor seal, other pinnipeds, and sea otters. Descriptions of these species and their important life history characteristics, population status, habitat requirements, prey species, and sensitivities to environmental stresses are discussed in further detail in Section 3.1 of the Groundfish Draft Programmatic SEIS.

Direct and indirect impacts of the alternatives on marine mammals are evaluated in Section 4.1 of this document and rated as either significant, conditionally significant, or insignificant. For this analysis, two direct and two indirect effects are evaluated:

- Direct Effects: Incidental take or entanglement
 Effects on Abundance of Prey
- Indirect Effects: Spatial and temporal harvest of prey
 Disturbance

4.13.1.2 Summary of External Factors and Consequences

A discussion of the external effects screened for cumulative effects analyses is presented in Section 4.13. The external effects determined to be applicable to the marine mammals cumulative effects analyses include the following.

Past External Effects:

- Foreign Fisheries (Section 2.7 of the Groundfish Draft Programmatic SEIS provides a description of the historical foreign fisheries in the region).
- Other Fisheries - joint venture (JV) and domestic groundfish fisheries (also see Section 2.7 of the Groundfish Draft Programmatic SEIS), State of Alaska managed fisheries, the International Pacific Halibut Commission (IPHC) managed halibut fishery, west coast drift gillnet fisheries.
- Subsistence harvest - both Alaskan and Russian native harvest
- Commercial harvest of seals and seal lions
- Commercial whaling
- Pollution - includes effects from the Exxon Valdez Oil Spill (EVOS)
- Climate Effects - short-term (El Nino), long-term (global warming), regime shift.

Present and Predicted Future Effects:

- Other Fisheries - State of Alaska managed fisheries (e.g., salmon drift and set gillnet, flatfish, sablefish and Pacific cod, herring roe and bait fishery, crab pot fishery), the IPHC managed halibut fishery, and west coast drift gill net fisheries.
- Subsistence harvest
- Climate effects - short-term, long-term, regime shift.

Table 4.13-1, which follows this section, summarizes the alternative ratings for each effects category and the addition of beneficial or adverse external effects. The table was developed following the approach outlined in Section 4.13. The geographic scope of effects considered in Section 4.1 and brought forward to Table 4.13-1 includes both the BSAI and the GOA. Not all of the external effects identified apply to all of the mammals species or groups. Discussions focusing on individual species or species groups follow and include information concerning external factors that are specific to the species or group.

The analysis of cumulative effects on marine mammals addresses species that were screened from the list of species or species groups discussed in Section 4.1 of this SEIS. Screening criteria for species to be included in the cumulative effects analysis consisted of the intensity of direct effects and impacts of the groundfish fisheries on these species or species groups, and the potential influence of the management regimes on the identified impacts. Species or species groups which were analyzed in this SEIS and found to have very limited interaction with the groundfish fishery and insignificant cumulative effects, were excluded from further analysis in this document. Species or species groups which show no substantial deviation from the effects of the Alternative 1, the no actions alternative, are discussed and analyzed only under that alternative.

Marine mammals are discussed as individual species for the Steller sea lion, northern fur seal, harbor seal, and sea otter. Species groups are collectively analyzed for other ESA listed marine mammals (listed Great Whales), other cetaceans, and other pinnipeds. Cumulative effect tables are presented to show the relationship

of the effect of the fisheries when added to the past, present, and reasonably foreseeable future external actions.

4.13.1.3 Species Analyzed for Cumulative Effects

Steller Sea Lions

Affected Environment Factors

The Steller sea lion ranges along the North Pacific Ocean rim, with centers of abundance and distribution in the GOA and Aleutian Islands, respectively ((Loughlin et al. 1984). Habitat of the Steller sea lion includes both marine pelagic and near shore waters, and terrestrial rookeries (breeding sites) and haulouts (resting sites). The northernmost breeding colony in the Bering Sea is on Walrus Island near the Pribilof Islands, and in the GOA on Seal Rocks in Prince William Sound, the northern most of all sea lion rookeries (Kenyon and Rice, 1961).

In the Bering Sea and GOA, the Steller sea lion diet consists of a variety of schooling fishes (e.g., pollock, Atka mackerel, Pacific cod, flatfish, sculpin, capelin, Pacific sand lance, rockfish, Pacific herring, and salmon), as well as cephalopods, such as octopus and squid (Calkins and Goodwin 1988, Lowry et al. 1982, Merrick and Calkins 1995, Perez 1990). Additional information on the diet and foraging habitats of the Steller sea lion is presented in Section 3.1.1 of this document.

The U.S. western stock has continuously declined since the 1960s, from around 177,000 (excluding pups) in the 1960s to 33,600 (excluding pups) in 1994. The U.S. eastern stock has remained relatively stable (Loughlin et al. 1992, Merrick et al. 1987). In 1990, the Steller sea lion was listed as threatened under the Endangered Species Act (ESA) throughout its range (see Section 3.4 of this document). A recovery plan was completed in 1992. In 1997, the National Marine Fisheries Service (NMFS) reclassified Steller sea lions as two distinct population segments, with the population segment west of 144°W, or approximately at Cape Suckling reclassified as endangered. The eastern stock remains listed as threatened.

Additional information on the life history and ecology of the Steller sea lion can be found in Section 3.1.1 and Appendix A (BiOP) in the document. Applicable external influences are presented in greater detail in Appendix J of the Groundfish Draft Programmatic SEIS (NMFS, 2000a).

Table 4.13-1 present the results of the cumulative effects analysis in matrix form for each alternative plan. Discussion and comparison of the results follow.

External Factors and Consequences

Past external adverse effects on Steller sea lions are discussed in further detail in Appendix J Section 1.2 of the Groundfish Draft Programmatic SEIS. Past effects were identified for foreign fisheries, other fisheries, commercial harvest and subsistence harvest. It was not until after the 1950s that large numbers of Steller sea lions were taken in the commercial fisheries in the regions (Alverson 1992). The take of Steller sea lions was substantial during this period with over 20,000 animals believed to have been incidentally killed in the foreign JV fisheries from 1966 to 1988, although data from this period is not complete (Perez and Loughlin 1991).

Other fisheries such as state-managed salmon drift and set gill net fisheries contributed to the overall take of Steller sea lions in the past. Intentional shooting of Steller sea lions also occurred in several near shore fisheries and this continued to some extent after the enactment of the Marine Mammal Protection Act

(MMPA) in 1972 until the early 1990s when they were listed as threatened under the Endangered Species Act (ESA) and a ban on shooting at Steller sea lions was enacted (Hill and DeMaster 1999).

Little information is available on the fluctuations of Steller sea lion population prior to the 1960s but it is suspected that decreases in population numbers were likely due to human exploitation (NRC 1996). Direct take of Steller sea lions during this early period has been estimated to range between about 300–500 animals annually (Hayes and Mishler 1991, Trites and Larkin 1992). Take of Steller sea lions in commercial fisheries after this period was considerable, with approximately 1,500 per year from 1966 to 1977 and 650 per year from 1978 to 1988. However, take of Steller sea lions had dropped dramatically to an average of 26 per year in the 1990s (Perez and Loughlin 1998, NMFS 2000c).

It is likely that historic commercial harvests of Steller sea lions for pelts also have had residual effects on the present day population levels of Steller sea lions in certain areas. However, a drastic decline in Steller sea lion numbers has still occurred in some North Pacific regions since protection for the species was instituted.

Foreign/joint venture fisheries and other fisheries were considered to have had negative effects on Steller sea lion populations and were rated as “-” for all effects category. Past subsistence and commercial harvest were also rated as “-” for incidental take and disturbance. Residual past influences were identified for all effects categories.

Present and predicted external effects on Steller sea lion incidental take include mortality from other fisheries. Based on satellite tracking data, Steller sea lions rarely travel outside the U.S. Exclusive Economic Zone (EEZ); therefore, the probability of Steller sea lion mortality from foreign fisheries is believed to be very low and insignificant (Hill and DeMaster 1999). The contribution to direct mortality of Steller sea lions from other fisheries is also relatively low; for the Prince William Sound drift gillnet fishery, the direct mortality is estimated at 14.5 animals per year for the years of 1990 and 1991 based on observer data (Hill and DeMaster 1999). Reported mortalities from six fisheries which did not employ observers are approximately 6.1 animals per year (Hill and DeMaster 1999). The total take from groundfish fisheries and other fisheries is approximately 30 animals per year (Hill and DeMaster 1999).

External effects of short-term or inter-annual climate changes such as the El Niño are not expected to result in population level effects on Steller sea lion since these animals are relatively long-lived, K-selected species. However, it is suspected that the steep declines in Steller sea lion numbers were due, in part, to long-term, climate-induced changes in the abundance and distribution of food for juveniles during a critical time in their life (NRC 1996). Long-term climate change or regime shifts can potentially affect Steller sea lions either positively or negatively, depending on the direction of the change. Long-term or inter-decadal climate change has been postulated as a primary factor in the current decline of the Steller sea lion which began in the early 1970s in the eastern Aleutian Islands, and then in the central and western Aleutian Islands and in the western GOA. It has been suggested that declines in food availability and in the abundance of high-quality forage fish resulted in food-related stress in several species of marine mammals and seabirds (Merrick et al. 1987, Piatt & Anderson 1996, Anderson & Piatt 1999). Additional discussion on the potential effect of climate on Steller sea lions is presented in the Biological Opinion, Appendix A, page 43 of this SEIS.

Subsistence harvest is a major external source of sea lion mortality in both the BSAI and GOA. Most of the subsistence harvest of Steller sea lions is by Aleut hunters targeting animals from the western U.S. stock in the Aleutian Islands and the Pribilof Islands (Wolfe et al. 1999). The mean annual harvest for the years 1993 to 1995 was 412 animals. In recent years, however, Steller sea lion harvest has decreased along with the overall population of sea lions. The subsistence harvest between 1996 and 1998 was approximately 182 animals per year, primarily from the western U.S. stock of Steller sea lions.

Analysis of Significance and Cumulative Effects

As summarized in Table 4.13-1, cumulative effects are presented for all alternatives for the four categories of direct/indirect effects: Incidental take/Entanglement, harvest of prey species, spatial/temporal concentration of harvest, and disturbance.

Incidental Take/Entanglement: Incidental take/entanglement of Steller sea lions is found to be cumulative based on the external effect of other fisheries and subsistence when added to the numbers of Steller sea lions taken by the groundfish fisheries. The estimated annual incidental take level of Steller sea lions under Alternative 1 in all areas combined is 13 (with a confidence interval [CI] = 10 - 16 sea lions; Table 4.1-2). If the take ratio is determined based on estimated TAC, the Steller sea lion take would be likely similar as past years since the same amount of fishing effort will occur, regardless of the number of seasons (two in this alternative).

When the annual take from fisheries is combined with the annual subsistence harvest, the total take is about 88 percent of the PBR of 234 animals as calculated under the MMPA for the western U.S. stock of Steller sea lions (Hill and DeMaster 1999). Entanglement of Steller sea lions in derelict fishing gear or other materials seems to occur at frequencies that do not have significant effects upon the population. Considering that the overall take including entanglement is below the PBR, the cumulative effect for Alternative 1 is considered to be insignificant.

Effects have been identified for foreign fisheries and state-managed fisheries, such as salmon and herring, through removal of important prey species of the Steller sea lion. Present and predicted effect on prey abundance is TAC for prey species of the Steller sea lion. The TAC of pollock, Pacific cod, and Atka mackerel under Alternative 1 is 1,831,297 mt. Together, the management actions imposed on the pollock, Atka mackerel and Pacific cod fisheries are likely to have reduced the likelihood of negative effects on Steller sea lions compared to circumstances in preceding years. Bycatch of non-target species important to sea lions under Alternative 1 is estimated to be less than 3% of the total catch in the Gulf of Alaska, and much lower in the Bering Sea (NMFS unpublished observer program data). The calculated daily catch removal rate was lower than the average removal rate of the other alternatives (deviation difference). This offset negative effect of the larger TAC for the major prey species and, overall, effect were considered insignificant.

Effects on prey are found to be cumulative based on external factor affecting prey overlain by the very large amount of prey species taken in the groundfish fishery. The cumulative effect is found to be conditionally significant adverse, largely based on the lack of information the availability of prey is not a factor in the decline of the species and the direct removal of large amounts of key prey species (pollock, Pacific cod and Atka mackerel) from foraging habitat by the groundfish fisheries. TAC relative to the fisheries in recent years would suggest that no substantial change in the rate of decline of the species would occur as a result of Alternative 1.

Spacial/Temporal Harvest of Prey: Past external adverse effects are identified relative to the spatial and temporal harvest of prey species of Steller sea lions. Currently, to minimize potential indirect interaction with Steller sea lions, the groundfish harvest seasons are managed to occur over broader geographic areas and over seasons that are less contracted in time. The management strategy under Alternative 1 to reduce the competitive interaction on prey species from the pollock and Atka mackerel fisheries involves both temporal and spatial dispersion of catch to reduce the local and acute effects of the fishery on densities of prey fish species within Steller sea lion critical habitat. These measures include creating additional Atka mackerel and pollock fishery exclusion zones around Steller sea lion rookeries or haulouts, phased-in reductions in seasonal proportions of TAC that can be taken from critical habitat, and additional seasonal TAC releases to disperse

the fishery over time. However, the pollock catch proportion from critical habitat in the GOA has actually increased. Therefore, the effect on prey under the Alternative 1 is rated as conditionally significant adverse.

Present and predicted external influences on spatial and temporal harvest of prey are identified primarily for other fisheries and were rated as "-". The effect on the spatial and temporal harvest of prey is considered cumulative and is found to be conditionally significant adverse for all alternatives based on uncertainty regarding the actual effects of harvest of Steller sea lion prey species within Steller sea lion foraging habitat. Under Alternative 2, which is designed specifically to maximize protection to marine mammals, this cumulative effect is found to be beneficial (conditionally significantly +) compared to Alternative 1 but still not enough to reverse the expected further decline in the population of Steller sea lions

Disturbance: Disturbance of prey by fishing activities is recognized as a potential factor affecting Steller sea lions but is not believed to produce effects at the population level. Past external influences of disturbance are identified for foreign fisheries and state-managed fisheries such as state-managed salmon and herring fisheries. The limits on fishing activity within critical habitat are expected to offer some level of protection from these disturbances. Disturbance from vessel traffic and acoustic disturbance from trawling is an ongoing condition of these areas, and Steller sea lions appear to be tolerant of at least some anthropogenic effects. Overall, the current level of disturbance related to the groundfish fishery is rated as insignificant.

Alternative 2

Alternative 2 is specifically designed to establish lower total allowable catch levels (TACs) for pollock, cod and Atka mackerel, prohibit trawling in Steller sea lion critical habitat, and implement measures to spread out catches throughout the year. External effects are the same as Alternative 1.

Incidental Take/Entanglement: Present and predicted effect of Alternative 2 in regards to take would be an improvement over Alternative 1, which was considered insignificant for this effect. The take from groundfish fisheries would be expected as a direct result of the reduction in TAC for pollock, cod and Atka mackerel. However, the total number of animals killed in the groundfish fishery under this alternative is expected to be less than 13 (as in Alternative 1) based on allocations of TAC. Reduced trawling activity in critical habitat would also tend to reduce the likelihood of incidental take a very small degree.

Effects on Prey: Present and predicted adverse effects on fisheries harvest of prey are identified for other fisheries such as State fisheries for salmon and herring. Effects under Alternative 2, the TAC of pollock, Pacific cod, and Atka mackerel under Alternative 2 is 1,627,859 mt which represents a substantial reduction (i.e., more than 5%) over Alternative 1. Comparing the average daily removal to the average of the other alternatives, the overall daily removal rate is similar to other alternatives (except winter). However, this varies by geographic area. This alternative further dampens the effects of ongoing harvest of the key prey species with different combinations of management measures and includes reductions in TACs. Combining all of these factor, direct effects of Alternative 2 on prey availability are considered insignificant.

The effect of harvest of prey species for Steller sea lions is considered to be cumulative based on both internal and external effect of harvest of Steller sea lion prey. The reductions in TAC under Alternative 2 represent a reduction from previous years, especially in the Aleutian Island. However, considering that data is lacking that would indicate food availability is not a factor in the recent declines of the Steller sea lion population, uncertainty still exists whether a reduction in TAC of 10% is enough to affect the rate of decline of the species. Therefore, the measures under this alternative are an improvement to Steller sea lions; however, the cumulative effect remains conditionally significant adverse.

Spacial/Temporal Harvest of Prey: Spacial/temporal concentration of fisheries is a key feature of Alternative 2. Present and predicted adverse effect on the spacial/temporal distribution of prey under Alternative 2, the effect of fisheries removal of prey species is reduced with a reduction in TAC and is expected to benefit Steller sea lions. Applicable to all fisheries is no trawling for any groundfish species within Steller sea lion critical habitat. Closures of critical habitat to trawling could potentially provide a large degree of separation between fisheries removal and foraging. The spreading of the catch between four seasons with daily catch limits should also reduce regional prey competition. Of all the alternatives, Alternative 2 appears to result in the least temporal concentration of fishery removals of key sea lion prey species. However, determining the magnitude of the effect for Alternative 2 on Steller sea lion metapopulations in general is not possible, except that in most cases it is likely to be beneficial. The fine resolution of management suggested in this alternative exceeds the resolution available on Steller sea lions; thus the effects of this alternative at the metapopulation level, or at finer scales, cannot be determined.

The spacial/temporal concentration of fisheries harvest is considered to be cumulative. The measures instituted under this alternatives with the combination of low TAC, daily catch limits and the considerable separation of the fisheries and critical habitat for Steller sea lions resulted in a rating of conditionally significant beneficial. Based on these factors, the cumulative effect rating was raised to the level of insignificant.

Disturbance: Present and predicted effect of disturbance is less than Alternative 1 due to the reduction of fishing activities in critical habitat and at haul out sides. A cumulative effect of disturbance is identified. However, any indication of an adverse effect is generally lacking and therefore, the cumulative effect is considered insignificant.

Alternative 3

Incidental Take/Entanglement: Incidental take would not likely result in substantial changes at the population level. Entanglement would not be expected to differ substantially from the Alternative 1. Take/entanglement is considered cumulative but is considered insignificant.

Effects on Prey: The effect of the harvest of Steller sea lion prey species under Alternative 3 is similar to Alternative 1 with the TAC of pollock, Pacific cod and Atka Mackerel of 1,627,859 mt but it is adjusted under the "global control rule". The largest reduction is for eastern and central GOA pollock which is 19% less than the TAC under Alternative 1, but the biological significant to Steller sea lions is questionable. Overall TAC for pollock is within 1 % of Alternative 1. Bycatch of species important to Steller sea lions under this alternative is also similar to Alternative 1. The direct effect of harvest of prey species was rated as insignificant. Effects of prey species is considered to be cumulative, and given the lack of distinction between this alternative and Alternative 1, cumulative effects are similar and considered conditionally significant adverse.

Spatial/Temporal Harvest of Prey: Present and predicted effects on spatial and temporal concentration of fisheries harvest of Alternative 3 generally spreads the fish removals over time and season, and thus results in marginally less spacial and temporal removals in comparison to Alternative 1. With no substantial reduction in TAC and relatively even daily removal rates, the benefits to Steller sea lions is similar to Alternative 1. This alternative reduces spatial concentration by creation large closures within three broad areas, prohibiting fishing within critical habitats during November 1 through January 20, and creates four rather than two seasons within critical habitats. The indirect effect of this alternative were considered conditionally significant beneficial for spacial and temporal harvest of prey.

Spacial/temporal harvest of prey is found to be cumulative. Although this alternative results in improvement to the spacial separation of Steller sea lion and the fisheries, there remains a lack of clear distinction between Alternative 3 and Alternate 1 in regards to the cumulative effect on Steller sea lions at the population level. The cumulative effect, therefore, are similar to Alternative 1 and considered conditionally significant adverse.

Disturbance: The cumulative effect of disturbance is similar to Alternatives 1 and other alternatives and considered insignificant.

Alternative 4

Incidental Take/Entanglement: Incidental take/entanglement for this alternative is expected be somewhat less than the Alternative 1 based on allocation of TACs. Take from the groundfish fisheries is expected to be less than 13 based or 1 per 140,000 mt of groundfish harvested. Take is found to be cumulative but considered insignificant under this Alternative.

Effects on Prey: The present and predicted fisheries harvest of prey species important to Steller sea lions under this alternative is 1,831,299 mt, similar to Alternatives 1, 3 and 5. The overall daily removal rate is an improvement and is rated as beneficial. Harvest of non-target species important to Steller sea lion is estimated to be less than 4 % of total catch in the GOA and much lower in the eastern Bering Sea. Since the harvest is essentially the same as the other alternatives, the cumulative effect would also be similar and considered insignificant.

Spatial/Temporal Harvest of Prey: Spatial and temporal concentrations of fishery harvest under this alternative is addressed by fishery specific closed areas around rookeries and haul-out sites, together with season and catch apportionments. Daily removal rates are fairly uniform throughout the year but in the Aleutian Islands, the daily catch rates for Atka mackerel, pollock and Pacific cod are the largest of all alternatives, especially in the critical spring period. A series of closures and removal rates further spreads out the catch. BiOp (NMFS, 2000) management Areas 4 and 9 and the Segum foraging area are closed to fishing for pollock, Pacific cod and Atka mackerel, and within 20 nm of five northern Bering Sea haul-outs. The closures of these areas is not likely be of great benefit to Steller sea lions, however, as the amount of pollock and Pacific cod catch, and Atka mackerel fishing effort in recent years has been minimal. Closures around rookeries and haulout result in spatial separation between fisheries and foraging habitat. Direct effect on spatial and temporal concentration of fisheries for Alternative 4 was considered insignificant.

Cumulative effects were identified for spatial/concentration of fisheries harvest of prey. The difference between Alternative 4 and Alternate 1 is likely indistinguishable on the population level. Cumulative effect, therefore, are similar to Alternative 1 and considered conditionally significant adverse.

Disturbance: The cumulative effect of disturbance is similar to Alternatives 1 and other alternatives and considered insignificant.

Alternative 5

Incidental Take/Entanglement: Present and predicted incidental take/entanglement for this Alternative is expected be somewhat more than the Alternative 1 based on allocation of TACs. Take from the groundfish fisheries is expected to be less than 14 based or 1 per 140,000 mt of groundfish harvested. Take is found to be cumulative but considered insignificant under this Alternative. There has been no significant trend in incidental take rates in either the BSAI or the GOA over the past decade.

Effects on Prey: The TAC of pollock, Pacific cod, and Atka mackerel under Alternative 5 is 1,809,497 mt, virtually the same as Alternatives 1, 3, and 4. The only reduction in TAC results from a prohibition on fishing for pollock in the Aleutian Islands, as in Alternative 2. The benefit to Steller sea lions from this reduction is equivocal. The average daily catch rates are an improvement and would be less than the averages of the other alternatives. This alternative also limits the amount of catch within Critical Habitat to be in proportion to estimated fish biomass. Because TAC under Alternative 5 is within 5% of the Alternative 1 TAC, effects on harvest of prey on Steller sea lions would be similar to Alternative 1 and are considered insignificant.

Cumulative effect of harvest of prey species abundance under Alternative 5 would be similar to Alternative 1 based on similar TAC levels and average daily removal rates. Cumulative effect is considered conditionally significant adverse, similar to Alternative 1.

Spatial/Temporal Harvest of Prey: Alternative 5 measures result in marginally less spatial and temporal concentration of fishery removals of key Steller sea lion prey species than do measures under Alternative 1. Removals are bimodal with peak removal rates of Atka mackerel Pacific cod, and pollock in the Spring and Autumn from Aleutian Island fishing areas, though of much lower magnitude. Spatial apportionments result in estimated daily average fish removal rates similar to those of Alternatives 3 and 4 for Eastern Bering Sea pollock and Pacific cod. Compared to other alternatives, estimated daily average removal rates from Aleutian Islands areas are lower during critical Spring and Summer months than in the other alternatives. Pacific cod and pollock estimated average daily removal rates in the Gulf of Alaska are most similar to the seasonal distribution of Alternative 4, and results in stepwise decreases from winter to summer. TAC levels are similar to those of the other alternatives except for Alternative 2, and hence the ultimate benefit to the Steller sea lion population may not be as great. Based on these factors, this indirect effect under Alternative 5 is rated as insignificant.

Since the effects of Alternative 5 are similar to Alternative 4 as far as the indirect effect of temporal/spatial harvest of prey, the cumulative effect is considered conditionally significant adverse, similar to the other alternatives.

Disturbance: The cumulative effect of disturbance is also similar to Alternatives 1 as well as the other alternatives and is considered insignificant.

Table 4.13-1 Steller Sea Lion

Alternative 1 - Past Influence

Direct/Indirect Effects of Groundfish Fishery	External Effects						
	Human Controlled			Natural Events			
Category	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commercial Harvest	Short-term Climate	Long-term Climate	Regime Shift
Incidental Take	-	-	-	-	0	0	0
Prey Availability	-	-	0	0	0	+/-	+/-
Spatial/Temporal	-	-	0	0	0	0	0
Disturbance	-	-	-	-	0	0	0
Past Influence? Y/N							Y
							Y
							Y
							Y

Alternative 1: No Action - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery	Rating	Alt. 1	External Effects						
			Human Controlled			Natural Events			
Category			Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift	
Incidental Take	I		-	-	-	0	0	0	Y
Prey Availability	I		-	-	0	0	+/-	+/-	Y
Spatial/Temporal	CS(-)		-	-	0	0	0	0	Y
Disturbance	I		-	-	0	0	0	0	Y
Cumulative Effect Y/N									Y
Conditionally Significant Y/N									N
Past Influence Y/N									Y
									Y
									Y
									Y

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-1 Steller Sea Lion (Cont.)

Alternative 2 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events						
	Alt. 2	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	Y	Y	N	
Prey Availability	I	-	-	0	0	+ / -	+ / -	Y	Y	Y -	
Spatial/Temporal	CS(+)	-	-	0	0	0	0	Y	Y	N	
Disturbance	I	-	-	0	0	0	0	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-1 Steller Sea Lion (Cont.)
Alternative 3 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events						
	Alt. 3	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	Y	Y	N	
Prey Availability	I	-	-	0	0	+/-	+/-	Y	Y	Y-	
Spatial/Temporal	CS-	-	-	0	0	0	0	Y	Y	Y-	
Disturbance	I	-	-	0	0	0	0	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-1 Steller Sea Lion (Cont.)

Alternative 4 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events						
	Alt. 4	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	Y	Y	N	
Prey Availability	I	-	-	0	0	+ / -	+ / -	Y	Y	Y-	
Spatial/Temporal	I	-	-	0	0	0	0	Y	Y	Y-	
Disturbance	I	-	-	0	0	0	0	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-1 Steller Sea Lion (Cont.)

Alternative 5 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events						
	Alt. 5	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	Y	Y	N	
Prey Availability	I	-	-	0	0	+/-	+/-	Y	Y	Y-	
Spatial/Temporal	I	-	-	0	0	0	0	Y	Y	Y-	
Disturbance	I	-	-	0	0	0	0	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Great Whales (ESA Listed)

Affected Environment Factors

Seven species of large whales that occur in Alaskan waters are listed under the ESA, including: the North Pacific right whale, blue whale, fin whale, sei whale, humpback whale, sperm whale, and bowhead whale. Direct interactions with groundfish fishery vessels have been documented between 1989 and 2000 for three of the seven species: fin, humpback, and sperm whales. There is generally little overlap between baleen whales and the groundfish fisheries. Several cases of entanglements in marine debris also have been reported for humpback and bowhead whales. Four of the seven species listed consume groundfish as part of their diet: fin, sei, humpback, and sperm whales. Additional information on the life history and ecology of these whales is found in Section 3.1.2 of the document.

Table 4.13.2, which follows this section, summarizes the direct and indirect effects of Alternative 1-5 as predicted in Section 4.1.2.3 of this SEIS. The table was developed using the approach outlined in Section 4.13.

External Factors and Consequences

As shown in Table 4.13-2 early commercial harvest of whales were found to have a substantial adverse effect on populations of great whales in the BSAI and GOA. Between 1950s and the 1970s, tens of thousands of whales were harvested in the North Pacific (NMFS 1991). Residual effects of this high level of harvest remain for most of the species, primarily as depressed populations with the possible exception of the gray whales. Other external effects include entanglement in fishing gear from state-managed fisheries such as salmon and herring. Mortality from entanglements are typically in the single digits per year (Hill and DeMaster 1999).

External effects are presented in Table 4.13-2. Present and predicted external effects are similar to past effects, except for mortality from commercial whaling which no longer occurs.

Analysis for Significance and Cumulative Effects

The cumulative effects analysis is depicted in Table 4.13-2. Cumulative effects were analyzed under Alternative 1, and the effects are not expected to differ across the alternatives.

Alternatives 1 through 5

Take/Entanglement: Past external and residual effects of commercial whales have been demonstrated for all of the great whales in the BSAI and GOA (except for gray whales). Present and predicted external effects are minor since commercial whaling is no longer conducted, but do include entanglement in west coast drift fisheries and subsistence whaling by Alaska Natives. Direct and indirect effects of the groundfish fisheries is primarily entanglement but this is quite rare for most species and doesn't result in effects at the population level. Therefore, the cumulative effect of take and entanglement is found to be cumulative but considered insignificant to all of the great whale species that occur in the BSAI and GOA.

Effects on Prey Abundance: There is very little overlap between fish targeted by the groundfish fisheries and species used by the great whales. Some baleen whales consume forage fish, herring and juvenile pollock. Toothed whales diet consists largely of fish and squid and generally do not overlap with groundfish fisheries, except for sperm whales which are known to predate fish, particularly sablefish, on longlines. However, interactions with commercial fisheries rarely result in an adverse effect on the whales. Direct effects of the

groundfish fisheries on removal of prey of the great whales are would not change more that 5 percent and this level intensity in considered insignificant all of the species considered.

Cumulative effect was identified, but considering the relatively low intensity of the interaction and the extent the whale would be affected by fishery removals, the cumulative effect on prey abundance was considered insignificant.

Spatial/Temporal Harvest of Prey: Based on the lack of overlap between the prey of these whales and the groundfish fisheries, no cumulative effect for spatial/temporal harvest was identified.

Disturbance: Past external effects of disturbance was identified for great whales throughout their range from foreign/joint venture fisheries, other fisheries, subsistence and commercial harvest. Present and predicted effect are similar except for commercial whaling which doesn't occur anymore. Based on the very minimal overlap between the groundfish fisheries, effect of disturbance for all of the alternatives is considered insignificant. This lack of direct or indirect effect resulted in no cumulative effect identified for disturbance.

Table 4.13-2 Great Whales (ESA listed)

Alternative 1 - Past Influence

Direct/Indirect Effects of Groundfish Fishery	External Effects								Past Influence Y/N
	Human Controlled				Natural Events				
Category	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commercial Harvest	Short-term Climate	Long-term Climate	Regime Shift		
Incidental Take	0	-	-	-	0	0	0	Y	
Prey Abundance	0	0	0	0	0	+/-	+/-	Y	
Spatial/Temporal	0	0	0	0	0	0	0	N	
Disturbance	-	-	-	-	0	0	0	Y	

Alternatives 1 through 5** - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		Rating	External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Alt. 1		Human Controlled		Natural Events			Regime Shift				
			Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate						
Incidental Take	I*		-	-	0	0	0		Y	N		
Prey Abundance	I*		-	0	0	+/-	+/-		Y	Y	N	
Spatial/Temporal	I		0	0	0	0	0		N	N		
Disturbance	I		-	0	0	0	0		Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *Effect is extremely negligible; essentially no actual effect

Other Cetaceans

Affected Environment Factors

Other cetaceans is a group of marine mammals consisting of ten species of whales and dolphins that occur in Alaskan waters and are protected under the MMPA (but not listed under the ESA) including: the gray whale, minke whale, beluga whale, killer whale, Pacific white-sided dolphin, harbor porpoise, Dall's porpoise and beaked whales (Baird's, Cuvier's and Stejneger's). Only five of these species have been documented to interact to some extent the groundfish fisheries. Interactions between commercial fisheries and a few of these species are well known, particularly predation of longline catch by killer whales. However, interactions which result in harm, other than occasional incidental takes, are essentially unknown.

Additional information on life history of the marine mammal group is presented in Section 3.1.3 of this document, and in Section 3.4.3 of the Groundfish Draft Programmatic SEIS (NMFS, 2000a).

External Factors and Consequences

External effects on this group have also been identified from state-managed fisheries such as salmon drift and set gillnet fisheries, but these effects are likely to be very minor. Little is known of possible past effects of climate change or regime shifts on these species. It is assumed that natural events could have both positive and negative effects, primarily to toothed whale prey. Since these are generally long-lived, K-selected species, short-term climate changes would not be expected to have substantial effects at the population level.

Present and predicted external influences would be expected to relate primarily to long-term climate change or regime shifts. The effects of these events on whales and porpoise are difficult to predict, but could potentially have either a beneficial or adverse effect.

External effects associated with the Alternative 1 are depicted in Table 4.13-3. Many of these effects are the same as those described above, with the exception of commercial whaling which is no longer a factor for whale mortality. However, these external effects are likely to be very insignificant in nature.

External influence are also presented in greater detail in Section 1.1, Appendix J of the Groundfish Draft Programmatic SEIS (NMFS, 2000a).

Analysis and Significance of Cumulative Effects

The cumulative effects analysis as described below is depicted in Table 4.13-3. No discernable difference was detected among the five alternative, therefore, effects are discussed together under Alternative 1.

Alternatives 1 through 5

Incidental Take/Entanglement: Past external effect from incidental take or entanglement is rare for this group. Records of toothed whale entanglement in derelict fishing gear are almost entirely absent (Laist 1997); therefore, the status quo has essentially no effect in this regard. A single minke whale mortality was reported in the BS/GOA joint-venture trawl fishery (predecessor of the current fishery) in 1989. The mortalities of killer whales have been documented in the BS trawls fishery (8), BS longline fishery (2) and GOA longline fishery (1). Effect of this mortality on killer whale populations is unknown.

Cumulative effect of incidental take/entanglement is only identified for some species such as the killer whale and Dall's porpoise. As a group, the contribution from the groundfish fisheries is minimal and considered

insignificant. For killer whales, the cumulative effect is unknown due to the lack of understanding on the effects on the population.

Effects on Prey Abundance: BSAI and GOA groundfish fisheries do not target prey items of baleen whales, thus the fisheries are unlikely to impact the whales through competition for prey. Little overlap occurs with the primary prey species of toothed whales with the possible exception of killer whales. Because of a general lack of clear effect attributable to the groundfish fisheries, a cumulative effect on the prey of this marine mammal group is not identified.

Spatial/Temporal Harvest of Prey: Given the lack of overlap with regard to prey species consumed by whales and porpoise relative to target species of the fisheries, spatial or temporal effects of harvest are not expected. Therefore, the effect is not found to be cumulative.

Disturbance: External factors of disturbance are identified for these whale and porpoise throughout their range. However, disturbances caused by vessel traffic, noise, or fishing gear are likely to be minimal. Given the minimal spatial, temporal, and dietary overlap with groundfish fisheries, the effect is found to be insignificant under the status quo. Present and predicted external factors are identified primarily as other fisheries, but the effects are also expected to be minor. The effect of disturbance is considered cumulative, but the low level of the effect on whales results in it being rated as insignificant.

Table 4.13-3 Other Cetaceans (not ESA listed)

Alternative 1 - Past Influence

Category	External Effects								Past Influence Y/N
	Human Controlled				Natural Events				
	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commercial Harvest	Short-term Climate	Long-term Climate	Regime Shift		
Incidental Take	-	-	0	-	0	0	0	0	Y
Effect on Prey	0	0	0	0	0	0	+/-	+/-	N
Spatial/Temporal	0	0	0	0	0	0	0	0	N
Disturbance	0	-	0	-	0	0	0	0	Y

Alternatives 1 Through 5 Past, Present and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects						Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
	Alt. 1	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift			
Incidental Take	I*	-	-	0	0	0	N		
Effect on Prey	I*	0	0	0	+ / -	+ / -	N		
Spatial/Temporal	I*	0	0	0	0	0	N		
Disturbance	I*	0	0	0	0	0	N		

Past Influence Y/N		Cumulative Effect Y/N	Conditionally Significant Y/N
Y			
Y			
N			
Y		N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *Effect is extremely negligible, or essentially no effect.

Northern Fur Seal

Table 4.13-4 which follows this section, summarizes the direct and indirect effects of Alternative 1-5 as predicted in Section 4.5 and of the pertinent external effects for northern fur seal throughout their range. The table was developed using the approach outlined in Section 4.13.

Affected Environment Factors

The northern fur seal ranges throughout the North Pacific Ocean from southern California north to the Bering Sea and west to the Okhotsk Sea and Honshu Island, Japan. Breeding is restricted to only a few sites: the Commander, Kuril and Pribilof islands, Robben Island, Bogoslof Island, and the Channel Islands (Gentry 1998). Like other otariids, northern fur seals have a highly polygynous mating system, breeding in dense colonies on islands located near highly productive marine areas (Gentry 1998).

Northern fur seals are apex predators such as Steller Sea lions and as such, ecological interaction between northern fur seals and the groundfish fisheries are caused by the spatial and temporal overlap between fur seal foraging areas and groundfish fisheries and from competition for target and bycatch species. Additional information on the life history and ecology of the northern fur seal is presented in Section 3.1.4 of this document and in Section 3.4.1 of the Groundfish Draft Programmatic SEIS (NMFS, 2000a).

A conservation plan for the northern fur seal was written to delineate reasonable actions to protect the species (NMFS 1993a). Fisheries regulations implemented in 1994 (50 CFR 679.22(a)(6)) created a Pribilof Islands Area Habitat Conservation Zone, in part to protect northern fur seals.

External Factors and Consequences

Past external effects are excerpt from those discussed in Appendix J, Section 1.3 of the Groundfish Draft Programmatic SEIS (NMFS 2001a). Incidental take of fur seals from foreign and joint venture trawl fisheries from 1978 to 1988 was approximately 22 animals per year (Perez and Laughlin 1991). The now prohibited foreign high seas drift net fisheries killed high numbers of fur seals, ranging annually from an average take in the low thousands up to 5,200 fur seals in 1991 (Hill and DeMaster 1999). Closure of the high seas drift net fishery has likely ended this substantial source of fur seal mortality.

Commercial harvest of fur seals has been a major source of human-induced mortality for over 200 years, and the abundance of fur seals has fluctuated greatly in the past, largely due to this commercial harvest (NMFS 1993). Commercial harvest of fur seals peaked during 1961 with over 126,000 animals harvested, and the commercial harvest of fur seals ended in 1985 (NMFS 1993). Residual effects of past commercial harvests on the fur seal population are possible, but recent population declines have overshadowed any potential lingering residual effects. The northern fur seal was listed as a depleted stock under the Marine Mammal Protection Act (MMPA) in 1988. The reason for the listing was the steep decline in numbers and lack of compelling evidence that the fur seal habitat carrying capacity had changed substantially during that time (NMFS 1993a). Under the MMPA, this stock remains listed as depleted until population levels reach at least the lower limit of its optimum sustainable population (estimated at 60 percent of carrying capacity). The northern fur seal population appears to be stable at the present time based on pup counts at breeding rookeries on Saint Paul and Saint George Islands (NMFS 1999).

Trawl closures around the Pribilof Islands, established mainly for the protection of crab stocks, may offer positive benefits for fur seals by limiting prey removals in waters surrounding the Pribilof Island rookeries. However, only northern fur seals that forage close to the islands would benefit by the availability of prey and recent tracking studies show that foraging trips of both adult female and juvenile male fur seals extend well beyond the trawl closure boundaries. Partitioning of foraging habitat by lactating fur seals on the Pribilof

Islands indicates that the Pribilof Islands Area Habitat Conservation Zone would primarily benefit females from northwest St. Paul Island and provide less protection to the foraging habitat of females from southwest St. Paul Island or St. George Island.

State-managed fisheries such as the salmon drift net fisheries have had a negligible effect on the overall take of fur seals since the average annual take attributed to these fisheries approaches zero.

Present and predicted external effects are similar to the past effects except for the commercial harvest of fur seals, an activity which no longer occurs.

Analysis and Significance and Cumulative Effects

As summarized in Table 4.13-4, cumulative effects are addressed for direct and indirect effects of fisheries.

Alternative 1

Incidental Take/Entanglement: Past external effect on northern fur seal mortality have been considerable and have contributed to population declines, especially from foreign fisheries and commercial harvest. Present and predicted external effects include mortality sources while these animals are outside the EEZ and small levels of take in State-managed gillnet fisheries in Prince William Sound, Alaska Peninsula and Bristol Bay.

The incidental take of northern fur seals is uncommon in the groundfish fisheries. The last recorded mortality in any Alaskan groundfish fishery occurred in 1996, when the take rate was one animal per 1,862,573 mt of groundfish harvested. This level of take contributes little to the northern fur seal PBR of 18,244 (Ferrero *et al.*, 2000) and is inconsequential to population trends.

Entanglement in marine debris is more common in fur seals than any other species of marine mammal in Alaskan waters (Laist, 1987, 1997; Fowler, 1988). Mortality of northern fur seals from entanglement in marine debris contributed significantly declining trends in the Pribilof Islands during mid to late 1970s and early 1980s (Fowler, 1988). The contribution of the groundfish fishery is thought to be less than in previous years but continues to affect the fur seal population. Considering the multiple sources of debris beyond the control of fisheries managers (i.e., foreign fisheries, international shipping, and shoreside refuse) and effects from the groundfish fisheries are decreasing, effects under Alternative 1 are considered insignificant.

Incidental take and entanglement are found to be cumulative largely based on external effects added to the effect of groundfish fisheries. Based on current entanglement rate, the cumulative effect under Alternative 1 is considered to be insignificant.

Effects on Prey Abundance: Past external effect on prey of northern fur seal has likely occurred to some extent from joint venture and foreign fisheries and potentially state-managed fisheries. Present and predicted external effect are likely associated with climate change or regime shifts based on the seals' wide distribution in the eastern Pacific which would make the susceptible to large-scale regional changes in climate.

Catches of squid and small schooling fish in the groundfish fisheries of the BSAI and GOA are very low and are not expected to effect fur seal populations. Fisheries for pollock do not target fish younger than 3 years of age, the preferred size by foraging fur seal (Ianelli *et al.*, 1999; Dorn *et al.*, 1999). The overall catch of pollock smaller than 30 cm is small, and thought to be only 1 to 4 percent of the number of one- and two-year olds each year in the eastern Bering Sea and GOA (Fritz, 1996).

While fisheries do harvest prey of northern fur seals (i.e., pollock and Pacific cod), competition due to the harvest rates of those species may vary depending on several factors. The overall catch of juvenile pollock has tended to be low in recent years and the degree to which adult pollock occur in the northern fur seal diet is not certain. While the potential overlap with fisheries may be moderated by these factors, effects on northern fur seals may yet exist, the relevance of which is not reflected by estimates of biomass removals over large geographical areas. Therefore, Alternative 1 is considered to have insignificant impacts on northern fur seals as the case for such effects may be weaker than the case for Steller sea lions.

Effects on availability of fur seal prey was found to be cumulative based primarily overlap of the groundfish fisheries and on the lack of information from the groundfish fisheries that food availability is not related recent population declines and may be affected by external factors (i.e. climate change). Based on these factors, the cumulative effect, however, is considered insignificant.

Spatial/Temporal Harvest of Prey: The competitive overlap between fisheries for Pacific cod and pollock and northern fur seals is influenced by several factors determining whether removals are concentrated in space or time:

- competition may vary depending on the availability of smaller prey in foraging areas.
- 45% of the catch from both fisheries occurs during the A Season in winter when female and juvenile male fur seals are not commonly found in the areas used by fisheries.
- fishery harvest rates during summer on adult pollock and Pacific cod in areas used by fur seals are below the annual target rates for the fish stocks as a whole (NMFS, 2000c).
- pollock fishery in the Bering Sea (summer season) begins on September 1, late into the fur seal breeding season (June-October).

While these factors lower the probability of adverse impacts stemming from spatial or temporal concentration of fisheries in northern fur seal foraging areas, changes in harvesting activity and/or concentration of harvesting activity in space and time may differentially impact fur seal foraging habitat at both the population and sub-population level. Given the uncertainty in the degree to which fur seals compete with the fishery for adult pollock in fur seal foraging areas where spatial and temporal overlap has been identified, it is assumed that conditionally significant adverse effects could occur under Alternative 1.

Spatial/concentration harvest of prey is considered cumulative and based on the potential overlap between fisheries and fur seal foraging habitat and based on remaining uncertainty as the effect of harvest on fur seal populations. This cumulative effect is considered conditionally significant adverse.

The potential for disturbance effects caused by vessel traffic, fishing gear, or noise appears limited for northern fur seals. Interactions with other types of fishing gear, such as trawl nets, also appear limited based on the rare incidence of takes in groundfish fisheries. Disturbance effects on northern fur seal prey are difficult to identify. Thus, the measures under Alternative 1 are consistent with efforts to avoid these kinds disturbance effects on northern fur seals. The variability of potential disturbance effects among years and between breeding groups on each island suggests that the intensity of disturbance is not well known, and that the disturbance effects under Alternative 1 (and all other alternatives) are unknown the population level.

A cumulative effect was identified for disturbance but lacking information on the actual effect of disturbance under this alternative, the cumulative effects was also considered unknown.

Alternative 2

Incidental Take/Entanglement: The incidental take of northern fur seals in the groundfish fisheries under Alternative 2 is expected to mirror rates under Alternative 1.

Effects on Prey Abundance: Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging habitat, and thus the gross amount of target and bycatch species caught will be lower than under Alternative 1. However, closure of the Steller sea lion Conservation Area will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. While the overall TACs is reduced under Alternative 2, there could be an increase in the fisheries harvest of prey species consumed by northern fur seals in the eastern Bering Sea. Overall, this potential increase in harvest of prey is offset by TAC reductions and effects on prey were rated as insignificant.

The effect on the abundance of prey is identified as cumulative, and considering decrease in TAC and limited overlap in prey size, the cumulative effect is considered insignificant.

Spatial/Temporal Harvest of Prey: While Alternative 2 reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and thus resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea, it results in an increase in the harvest rate on these species in areas where fur seals forage. Alternative 2 also expands the timing of the fishery from only September and October to the entire season when fur seals are breeding on the Pribilof Islands (June -October). While this change slows the pace of the fishery; it may also increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution and may substantially change the level of interactions.

Areas closed to fishing in the eastern Bering Sea under Alternative 2 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Anaemic Pass and on the shelf to the east of the Islands in the Pribilof Islands Conservation Area . Alternative 2 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery and increase the spatial and temporal interactions of the groundfish fisheries with northern fur seals relative to Alternative 1. This alternative was rated as conditionally significant adverse in that effects on fur seal would be increased.

Spatial/temporal harvest of prey is identified as cumulative based on external effects. There potential increase in harvest activity in northern fur seal foraging areas as a result of being displaced from closed areas. Overall, this increase in spatial and temporal interaction in foraging habitat and lacking any information that the recent declines are not food related, the cumulative effect was considered conditionally significant adverse.

Disturbance: Alternative 2 is not expected to result in new forms of disturbance; however it may intensify those previously discussed under Alternative 1. Relative to Alternative 1, the level of disturbance due to the activity of fishing vessels will increase in northern fur seal foraging habitat if similar area closures are implemented under Alternative 2. The expansion of the timing of the fishery under Alternative 2 from September-October to the entire season when fur seals are breeding on the Pribilof Islands (June - October) will increase the disturbance in fur seal foraging habitat and increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. The disturbance effect is rated as conditionally significant adverse.

The disturbance from Alternative 2 is similar to Alternative 1, therefore, the cumulative is also considered unknown.

Alternative 3

Incidental Take/Entanglement: The incidental take of northern fur seals in the groundfish fisheries under Alternative 3 is expected to mirror rates under Alternative 1. Therefore, cumulative effects is considered insignificant.

Effects on Prey Abundance: As with Alternative 2, closure of R.A. Areas (Area 8 and 9) under Alternative 3 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. The percentage of the TAC occurring during the C/D seasons will increase to 60% from 55% during the B season under Alternative 1. The increase of total catch occurring in fur seal foraging habitat due to the redistribution of fishing effort away from Steller sea lion critical habitat described under Alternative 2 will likely increase the bycatch of juvenile pollock, forage fish and squid in northern fur seal foraging habitat. In addition, the shift in the beginning of the from 9/1 to 6/1 will increase competition during the fur seal breeding season. The bycatch of juvenile pollock is typically highest during the summer season in the outer shelf domain when spawning aggregations are dispersed and adult and juvenile pollock are found in the same areas northwest and west of the Pribilof Islands (Fritz, 1996). Current diet information is not sufficient to assess the degree to which fur seals compete with the fishery for adult pollock, however both recent fatty acid and stable isotope analyses of fur seal diets in addition to historical data based on stomach sampling indicate that fur seals consume adult pollock. The intensity of competition will logically increase as more fishing occurs in fur seal foraging areas. However, the magnitude of the competition is not expected to have population level, and therefore, was rated as insignificant.

Based on external effect and the magnitude of the direct effect on prey, the cumulative effect in regards to prey abundance under Alternative 3 is considered insignificant, similar to Alternative 1.

Spatial/Temporal Harvest of Prey: Alternative 3 also reduces the catch of pollock and Pacific cod in Steller sea lion foraging areas and with the exception of opening Area 7 to fishing, resembles the critical habitat protections implemented during the 2000 summer fishery in the Bering Sea. In 2000, the shift in fishing effort relative to the 1998 fishery caused an increase the harvest rate on prey species in areas where fur seals forage. This alternative could increase the likelihood of localized effects due to the concentration of the fishery in fur seal foraging habitat. In addition to the possibility of increased bycatch of fur seal prey species during the breeding season, any overlap in the size of groundfish taken by the fishery and fur seals will be exacerbated by temporal shifts in catch distribution.

Areas closed to fishing in the eastern Bering Sea under Alternative 3 include habitat used by foraging fur seal females breeding on the Pribilof Islands. This includes the waters north of Anaemic Pass in the CVOA and SSL Conservation Area and in the Pribilof Islands Conservation Area, as well as 20 nm closures around the Pribilof islands. While catches of fur seal prey will be lower in these areas, Alternative 3 does not account for the biomass of the target species in the area closed to fishing. This could increase harvest rates in areas open to the fishery relative to Alternative 1. Given that Alternative 3 will likely increase in the spatial and temporal interactions of the groundfish fisheries with northern fur seals relative to Alternative 1, it was rated as conditionally significant adverse.

Given the increased overlap of the groundfish fisheries with fur seal foraging habitat, and the similarity to Alternative 1, the cumulative effect under Alternative 3 in regards to the spatial/temporal harvest of prey is considered conditionally significant adverse (similar to Alternative 1).

Disturbance: The spatial and temporal overlap of the fishery and northern fur seal foraging habitat resulting from the closure of Area 8 in the CVOA and Area 7 in the SSL Conservation Area under Alternative 3 will result in an increase in the number of hours trawled in areas where fur seals forage and therefore, the level of disturbance due to the activity of fishing vessels will likely increase if area closures are implemented under Alternative 3. However, the effect of this increased disturbance to the fur seal and/or their prey field is unknown.

Disturbance is found to be cumulative, and even though disturbance would likely increase under Alternative 3, effects of this disturbance on northern fur seal is generally lacking, the cumulative effect is considered unknown.

Alternative 4

Incidental Take/Entanglement: The incidental take of northern fur seals in the groundfish fisheries under Alternative 4 is expected to mirror rates under Alternative 1. Therefore, cumulative effects is considered insignificant.

Effects on Prey Abundance: Alternative 4 represents little change in the harvest of fur seal prey species relative to Alternative 1. Under Alternative 4 increased competition for prey species in fur seal foraging habitat will occur from the seasonal shift in the timing of the fishery (September and October under Alternative 1 to June -October under Alternative 4). The highest bycatch of small pollock occurs during early summer (May-July) when spawning aggregations have dispersed and pollock are generally less segregated by size (Fritz, 1996). There is the possibility of increased bycatch of fur seal prey species during the breeding season due temporal shifts in catch distribution. However, the magnitude of this increase is not expected to affect the fur seal population as a whole. Alternative 4 was rated as insignificant, similar to Alternative 1.

Since harvest would of prey species would be similar to Alternative 1, cumulative effects for prey abundance under is also similar to Alternative 1 and considered insignificant.

Spatial and Temporal Concentration: Under Alternative 4, only the Sea Lion Conservation Area will be closed to trawling for pollock and catcher-processors will be excluded from the CVOA from June 10 to December 31. This will shift the spatial distribution of the fishery into fur seal foraging habitat to some degree, however it is difficult to predict whether increased competition will occur due to the harvest of prey species. As with Alternatives 2,3 and 5, Alternative 4 expands the timing of the fishery from only September and October (Alternative 1) to the entire season when fur seals are breeding on the Pribilof Islands (June - October). Given the uncertainty of the effect of increased fishing in fur seal habitat during June-August, the effects of Alternative 4 were rated as conditionally significant adverse.

Spatial/temporal harvest of prey species is considered cumulative. Based on external effects and an increase in interaction with the groundfish fisheries, the cumulative effect under this alternative is considered conditionally significant adverse, similar to Alternative 1.

Disturbance: The disturbance effects under Alternative 4 mirror the possible effects resulting from the spatial and temporal concentration of the fishery under Alternative 3. Given the uncertainty regarding the potential disturbance to the fur seal prey field of increased fishing in fur seal habitat during June-August, in addition to variability in the effects of on different foraging areas, Alternative 4 was rated as unknown.

Disturbance is found to be cumulative based on external effect and effects of the groundfish fisheries, and lacking an indication of actual effect on northern fur seal from this disturbance, the cumulative effect is found to be unknown, similar to the other alternatives.

Alternative 5

Incidental Take/Entanglement: The incidental take of northern fur seals in the groundfish fisheries under Alternative 5 is expected to mirror rates under Alternative 1. Therefore, cumulative effects is considered insignificant.

Effects on Prey: Alternative 5 limits the amount of catch within Steller sea lion critical habitat to be in proportion to estimated fish biomass. To the extent that fishing effort is displaced from the Steller sea lion Conservation Area, Alternative 5 will redistribute fishing effort for pollock in the eastern Bering Sea northward toward the Pribilof Islands during the fur seal breeding season. As with Alternatives 2-4, Alternative 5 also expands the timing of the fishery from only September and October to June -October when fur seals are breeding on the Pribilof Islands and the intensity of competition will may increase as more fishing occurs in fur seal foraging areas. For these reasons, Alternative 5 was rated similar to Alternatives 2 and 4 and considered insignificant.

Since Alternative 5 is generally similar to Alternatives 2 and 4 in extending fisheries in fur seal foraging areas, the cumulative effect on prey abundance and availability would be similar and considered insignificant.

Spatial and Temporal Concentration: The implementation of the R.A. measures during the 2000 summer fishery in the Bering Sea, increased the proportion of total June-October catch in fur seal meta-home ranges from 47% in 1998 to 64% in 2000. Relative to Alternative 1 (which represents regulations for the 1998 pollock fishery). This reflects a change in the impact on northern fur seal foraging habitat. Alternative 5 also expands the timing of the fishery from only September and October to cover the entire season when fur seals are breeding on the Pribilof Islands (June -October). Alternative 5 allows fishing in critical habitat in proportion to the estimated fish biomass and may result in less overlap outside of areas closed to fishing. This effect will depend on the degree of overlap in the size of fish taken by fur seals and fisheries. Alternative 5 differs from Alternative 1 in that it represents probable increases in the spatial and temporal interactions of the groundfish fisheries with northern fur seals and, therefore, was rated as conditionally significant adverse.

A cumulative effect was identified based on external factors and from indirect effects of the groundfish fisheries under Alternative 5. This cumulative effect is considered conditionally significant adverse, primarily based on the increase in spatial/temporal interaction from displacement of fishing effort from Steller sea lion critical habitat.

Disturbance: As discussed for Alternatives 2-4, changes in the timing of the fishery under Alternative 5 will increase the period of disturbance in fur seal foraging habitat to cover the entire breeding season (June-October). Given that Alternative 5 may increase the disturbance to the fur seal prey field relative to Alternative 1, it was rated as unknown .

Disturbance under Alternative 5 is similar to Alternative 2 and 4, and therefore, the cumulative effect is also similar and considered unknown. This finding is based on the lack of information on the actual effect of disturbance from fishing activities on foraging northern sea lions. .

Table 4.13-4 Northern Fur Seal

Alternative 1 - Past Influence

Direct/Indirect Effects of Groundfish Fishery	External Effects								Past Influence? Y/N
	Human Controlled				Natural Events				
Category	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commerci al Harvest	Short-term Climate	Long-term Climate	Regime Shift		
Incidental Take	-	-	-	-	0	0	0	Y	
Prey Availability	-	-	0	0	0	+ / -	+ / -	Y	
Spatial/Temporal	-	-	0	0	0	0	0	Y	
Disturbance	-	-	-	-	0	0	0	Y	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-4 Northern Fur Seal (Cont.)

Alternative 1 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects									
Category	Rating	Human Controlled				Natural Events			Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
	Alt. 1	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	0	Y	Y	N
Prey Availability	I	-	-	0	0	0	+ / -	+ / -	Y	Y	N
Spatial/Temporal	CS(-)	-	-	0	0	0	0	0	Y	Y	Y-
Disturbance	I	-	-	0	0	0	0	0	Y	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-4 Northern Fur Seal (Cont.)

Alternative 2 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery	
Category	Rating
	Alt. 2
Incidental Take	I
Prey Availability	I
Spatial/Temporal	CS(-)
Disturbance	I

External Effects					
Human Controlled			Natural Events		
Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift
-	-	-	0	0	0
-	-	0	0	+/-	+/-
-	-	0	0	0	0
-	-	0	0	0	0

Past Influence Y/N
Y
Y
Y
Y

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	N
Y	N
Y	Y-
Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-4 Northern Fur Seal (Cont.)

Alternative 3 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events			Regime Shift			
	Alt. 3	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate					
Incidental Take	I	-	-	-	0	0	0	0	Y	Y	N
Prey Availability	I	-	-	0	0	+ / -	+ / -	+ / -	Y	Y	N
Spatial/Temporal	CS(-)	-	-	0	0	0	0	0	Y	Y	Y-
Disturbance	I	-	-	0	0	0	0	0	Y	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-4 Northern Fur Seal (Cont.)

Alternative 4- Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events					
	Alt. 4	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift			
Incidental Take	I	-	-	-	0	0	0	Y	N	
Prey Availability	I	-	-	0	0	+ / -	+ / -	Y	N	
Spatial/Temporal	CS(-)	-	-	0	0	0	0	Y	Y-	
Disturbance	I	-	-	0	0	0	0	Y	N	

Table 4.13-4 Northern Fur Seal (Cont.)

Alternative 5 - Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events						
	Alt. 5	Foreign Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift				
Incidental Take	I	-	-	-	0	0	0	Y	Y	N	
Prey Availability	I	-	-	0	0	+ / -	+ / -	Y	Y	Y-	
Spatial/Temporal	CS(-)	-	-	0	0	0	0	Y	Y	Y-	
Disturbance	I	-	-	0	0	0	0	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Harbor Seal

Affected Environment Factors

Harbor seals inhabit coastal and estuarine waters off Baja California, north along the western coasts of the United States, British Columbia, and southeast Alaska, west through the GOA and Aleutian Islands, and in the Bering Sea north to Cape Newenham and the Pribilof Islands. Harbor seals are not listed as threatened or endangered under the ESA nor are they designated as depleted under the MMPA.

Harbor seals have a relatively diverse diet, but there is overlap with commercial groundfish fisheries. Major food items for harbor seals vary by availability and include sand lance, smelt, sculpins, herring, capelin, shrimp, mysids, octopus, pollock, and flatfishes (Lowry et al., 1982). In the Gulf of Alaska during the 1970s harbor seals fed primarily, in order of frequency, on pollock; octopus and capelin (Pitcher, 1980). Harbor seals have a relatively diverse diet, but there is overlap with groundfish fisheries, primarily for pollock, Atka mackerel, and Pacific cod. Therefore, harbor seals may be indirectly affected by the groundfish fisheries, especially in the GOA and Aleutian Islands regions.

Tables 4.13-5, which follows this section, summarizes the direct and indirect effects of Alternative 1-5 as predicted in Section 4.5 and of the pertinent past and present external effects for harbor seal throughout their range. The table was developed using the approach outlined in Section 4.13.

External Factors and Consequences

Past external effects on harbor seal are presented in Table 4.13 -5. These external effects were screened from a wide variety of potential factors which influenced the harbor seal populations. The dominant influences considered in the cumulative effects analysis include past commercial harvest, subsistence, and other fisheries (foreign joint venture and state-managed). Detailed description of past influences on harbor seals are provided in Appendix J, Section 1.2 of the Groundfish Draft Programmatic SEIS (NMFS, 2001).

Foreign JV fisheries have likely contributed to some level of harbor seal mortality but there is minimal data on the actual effects. Based on the near shore distribution of harbor seals, there was likely negligible interaction between the early foreign fisheries and harbor seals and mortality is believed to have been very low.

State-managed fisheries, primarily salmon set and drift gillnet fisheries, have contributed to harbor seal mortality in the past from direct interaction with fishing activities. Harbor seal mortality in the state-managed salmon drift and set net fisheries has been estimated to average about 31 animals per year over a 6-year period for the Bristol Bay area, one of the most heavily fished areas (Hill and DeMaster 1999). The effect of other state-managed fisheries on harbor seals would be expected to be much lower. These fisheries self-report harbor seal mortality; therefore, the actual take of animals in these fisheries is likely under-reported.

Commercial harvest of harbor seals occurred on a regular basis throughout the animal's range until the early 1970s following passage of the Marine Mammal Protection Act of 1972 (MMPA). Both adult seal and pups were harvested for pelts (Pitcher and Calkins 1979). Harvest rates from this early period could have residual effects on the present day harbor seal population in many areas.

External effects associated with the groundfish fishery are depicted in Table 4.13-5. Most of the present and predicted external effects are similar to the past effects except for the commercial harvest of seals, which no longer occurs. Pollution events such as the Exxon Valdez Oil Spill (EVOS) can also adversely affect harbor seals (Frost et al. 1996). These events are very rare and were not considered as major external influences. Past

external effects contributing to incidental take of harbor seals are identified for foreign and joint venture fisheries, state-managed fisheries, the subsistence, and commercial sealing. Incidental take of seals in commercial groundfish fisheries in the GOA and BSAI is uncommon largely due to the near shore distribution of this species. Collectively, harbor seal mortalities attributable to fisheries amount to less than 0.2 percent of the GOA and southeast Alaska harbor seal rate of potential biological removal (PBR) for these stocks (Hill and DeMaster 1999). In the BSAI, fisheries-related mortality of harbor seals represents approximately 1 percent of the PBR of the Bering Sea harbor seal population. These low levels of take are considered insignificant to the population as a whole.

Present and predicted external influences include other fisheries and the subsistence harvest. The near shore distribution of harbor seals results in direct interaction with several State-managed fisheries, such as the Bristol Bay salmon drift and set gillnet fisheries, with a take of approximately 27 animals per year. Fisheries in the Prince William Sound, Cook Inlet, and Kodiak set gillnet and Alaska Peninsula drift gillnet and set gillnet fisheries which collectively account for mortality of approximately 10 animals per year (Hill and DeMaster 1999). Approximately 31 animals per year are lost through interaction with GOA fisheries (PBR=868).

Harvest of harbor seals for subsistence purposes is likely the highest cause of anthropogenic mortality for this species since the cessation of commercial harvests in the early 1970s. The annual subsistence harvest from this stock from 1994 to 1996 was approximately 161 animals, well below the PBR (379). The average annual subsistence harvest from the GOA between 1992 and 1996 was 791 animals, just below the PBR for this stock. The latest available harvest data from 1998 (792) is comparable to the average subsistence harvest of harbor seals from previous years (Wolfe 1999).

Analysis and Significance of Cumulative Effects

Table 4.13-5 present the results of the cumulative effects analysis in matrix form for each alternative plan. This table was developed following the approach outlined in Section 4.13.

Alternative 1

Incidental Take/Entanglement: Past external effects contributing to incidental take of harbor seals are identified for foreign and joint venture fisheries, state-managed fisheries, the subsistence, and commercial sealing. Overall, the effect of take of harbor seals is found to be cumulative due to the additional external mortality as discussed above. The contribution from the groundfish fisheries to total take of harbor seals is quite small relative to the subsistence harvests. However, considering the total take is well below the PBR for this species, the cumulative effect is considered insignificant.

Effect on Prey abundance: Past adverse external effects on harbor seal prey availability are identified for foreign fisheries, state-managed fisheries, and the potential effects of climate change or regime shifts. The direct and indirect effect of Alternative 1 on availability of prey was considered conditionally significant adverse, based on the uncertainty of impact on the local level. Overlap in species targeted by harbor seals and the fisheries also occurs with state-managed fisheries such as salmon and herring. Other possible external effects can result from climate change (positive or negative) or effects of a regime shift on prey species availability. With the contribution of external factors, a cumulative effect is identified and is rated as insignificant.

Spatial/Temporal Harvest of Prey : Present and predicted external influences on spatial/temporal harvest are identified for other fisheries such as state-managed fisheries. Spatial partitioning between the offshore commercial groundfish harvest and the near shore distribution of harbor seals limits the degree of competition

for prey species. Fishery harvests from nearshore areas used as by harbor seals as foraging habitat would have a much greater effect on seals than pelagic fishery removals.

To the extent that a portion of harbor seal foraging may occur in areas fished by the groundfish fisheries under Alternative 1, this effect was rated as conditionally significant adverse. However, the degree of overlap with fisheries is less pronounced with harbor seals than with Steller sea lions. The effect is found to be cumulative and is rated as conditionally significant adverse.

Disturbance: Disturbance by the groundfish fisheries appears to be limited for harbor seals due to their near shore distribution and is likely not a important consideration for harbor seals and is rated as not significant. External effects of disturbance are considered primarily from other fisheries, such as State-managed salmon and herring and the disturbance effects are considered cumulative. However, there is little evidence that suggests this level of disturbance adversely affects harbor seals and, therefore, the cumulative effect is considered insignificant.

Alternative 2

Alternative 2 is specifically designed to establish lower total allowable catch levels (TACs) for pollock, cod and Atka mackerel, prohibit trawling in Steller sea lion critical habitat, and implement measures to spread out catches throughout the year.

Take/Entanglement: In both the GOA and BSAI, groundfish fisheries takes of harbor seals are at levels approaching zero and are not considered significant factors in population trends. Reported cases of harbor seal entanglement in marine debris are less prevalent than for northern fur seals or Steller sea lions (Laist, 1987, 1997). Given their inshore distribution and the high frequency with which they are observed, the low incidence of entanglement is unlikely to be a result of few opportunities to document such events. Thus, the effects of direct take and entanglement under Alternative 1 are considered to be insignificant.

Take and entanglement of harbor seals is considered cumulative based on external factors such as subsistence. Since the total take of seals is below 1% the PBR for the BSAI and GOA, the cumulative effect is considered insignificant.

Effects on Prey Abundance: In the GOA and BSAI, pollock, Pacific cod and Atka mackerel are consumed by harbor seals. The potential for competitive interaction from fisheries exists; however, competition would be largely dependent on the amount of fish removed and the temporal and spatial distribution of fishing effort. Alternative 2 substantially reduces the TAC in the GOA and BSAI, which would result in a reduced competitive interaction with harbor seals. Maximum daily catch limits are likely to provide beneficial effects to foraging harbor seals. Effects on prey are rated as conditionally significant beneficial.

Effects on prey abundance are found to be cumulative considering the external effects of state -managed fisheries. Considering the limited overlap with groundfish fisheries, benefit to the harbor seal on the population level would likely be not be realized. With the contribution of external factors, a cumulative effect is identified and is rated as conditionally significant adverse for this effect.

Spatial/Temporal Concentrations: Present and future effects of the spatial/temporal harvest of harbor sea prey are primarily related to near shore state-managed fisheries since harbor seals exhibit a preference for nearshore habitat. These animals do not range far and feed at shallow depths on a variety of prey, including pollock, Pacific cod and Atka mackerel. Harbor seals would receive some protection from competitive interaction for prey resources under Alternative 2 to the extent that no transit/no trawl fishing areas exist within 3-20 nm of shore in areas of Steller sea lion haulout sites and rookeries that overlap with harbor seal locations. This is particularly so in the Aleutian Islands area where many of the no transit and trawl exclusion

zones exist. A lesser degree of protection would be afforded in the Gulf of Alaska where fewer restricted areas are described in areas that overlap with nearshore harbor seal distribution.

Except for harvest limits (40% of TAC) in critical habitat, including the Shelikof Conservation Area, few spatial restrictions exist around the Kodiak Archipelago, an area of significant harbor seal decline. A similar situation exists for Prince William Sound; however, the extent of federal groundfish fisheries in PWS is not substantial. Overall, the effect of this alternative is considered insignificant for temporal spacial distribution of fishing effort.

Temporal/spacial concentration of fisheries harvest of harbor seal is found to be cumulative based on external factor and effect of the groundfish fisheries. Based on the closure of large area around Steller sea lion rookeries and haulouts for trawling and the increased separation between the groundfish fishery and harbor seal habitat, the cumulative effect under this alternative is found to be insignificant.

Disturbance: No new types of disturbance to harbor seal would occur as a result of this alternative in comparison to Alternative 1. Evidence of an adverse effect of disturbance from fishing activity on harbor seals is generally lacking. Overall, interaction with harbor seals would be decreased with closures around sea lion rookeries and haulouts. Disturbance is considered to be cumulative based on external effect but the cumulative effect is found to be insignificant.

Alternative 3.

Take/Entanglement: The TAC levels under Alternative 3 will be somewhat reduced from Alternative 1 but since the incidental take of harbor seals in these fisheries is already at a negligible level, further reductions in TAC would likely not represent a significant positive impact to harbor seal populations. Take is considered insignificant under Alternative 3. Since there is little difference between alternatives and overall take is below the PBR, cumulative effect of take would be considered insignificant.

Effects on Prey Abundance: Reduced catches of GOA pollock, Bering Sea cod and Aleutian Islands cod could be marginally better for harbor seals. However, TAC levels under Alternative 3 are essentially the same as Alternative 1 and daily removal rate do not affect inshore feeding harbor seal, therefore, the cumulative effect would be similar and considered insignificant.

Temporal/Spatial Concentrations of Harvest: Alternative 3 creates no transit zones within 3 nm of 37 rookeries and no fishing zones within 3 nm of haulout sites similar to Alternatives 1 and 2. Some of the closure areas overlap with areas of harbor seal haulout sites. As a result, harbor seals would also benefit from these closures. Important areas for harbor seals around the southern part of Kodiak Island (area 3 under this Alternative), area 5, and area 7 would remain open. Numerous harbor seal haulout sites occur in these areas. The Kodiak area has experienced a significant decline in harbor seal populations over the last 20 years (~80%). While some increase in population has occurred in recent years, the population remains significantly depressed from historical levels.

Closures in critical habitat during the winter would mitigate some of this impact; however, to the extent that fishing effort occurs in relatively defined open areas in the summer when harbor seals are pupping and nursing their young, the animals' ability to find adequate forage could be reduced. Temporal distribution of fishing effort both inside and outside critical habitat could provide some degree of mitigation for these effects.

Temporal/spacial concentration of harvest is found to be cumulative based on external effect of State-managed fisheries when overlain by the groundfish fisheries. Considering the lack of information that recent declines are not related to competition with fisheries activities, the cumulative effect is considered conditionally significant adverse.

Disturbance: To the degree that fishing becomes more concentrated in open areas, harbor seals in those areas could experience an increased disturbance effect. Generally, present and predicted disturbance under Alternative 3 would be similar to Alternative 1 and, therefore, considered insignificant. Cumulative effect would be similar to other alternatives and considered insignificant.

Alternative 4

Take/Entanglement: The TAC under Alternative 4 is virtually unchanged from the TAC level under Alternative 1 or 3; therefore take is considered insignificant similar to the other alternatives. Cumulative effect of take are also similar to the other alternatives and considered insignificant.

Effects on Prey Availability: Present and predicted effect of prey availability would be similar to Alternatives 1 and 3 since the TAC is essentially unchanged. Cumulative effects would also be the same as Alternative 1 and 3 and is considered insignificant.

Temporal/Spatial Concentration: No transit zones and no fishing zones occur within 3 nm of 37 rookeries and no fishing occurs within 0 - 20 nm of only 5 northern haulout sites. The nearshore protection is more selective than in the other alternatives. Closures to Atka mackerel fishing in the Aleutian Islands, fishing to pollock fishing in the central and western Aleutian Island, closures for Pacific cod in the BSAI in near shore habitat, closures in the GOA would also provide some protection from competitive interaction. However, this alternative leaves open a large extent of the eastern and southern areas of Kodiak Island to pollock and some Pacific cod fishing and the eastern and southern sides of Kodiak Island. Areas in Chignik and around Dutch Harbor could be affected negatively by fishing pressure on Pacific cod in the near shore environment.

The temporal dispersion of TAC harvest throughout the year so as to minimize large scale removals in any one area could provide some benefit to harbor seals but would depend on the specific details of seasonal openings and areas fished. Changes in TAC by area could allow more fishing inshore and result in increased competitive pressure. Overall, effect on temporal/spatial concentration of harvest is rated conditionally significant adverse.

Based on the external effects of state-managed fisheries on prey and the lack of definitive improvement for harbor seals under this Alternative, the cumulative effect is considered conditionally significant adverse.

Disturbance: No new types of disturbance to harbor seal would occur as a result of this alternative. Evidence of an adverse effect of disturbance from fishing activity on harbor seals generally lacking. Overall, interaction with harbor seals would be decreased with closures around sea lion rookeries and haulouts. Disturbance is considered to be cumulative based on external effect but the cumulative effect is found to be insignificant.

Alternative 5

Incidental Take/Entanglement: The incidental take of harbor seals in the BSAI and GOA fisheries is minimal and not considered to be problematic for harbor seal populations. That take level is not expected to change under Alternative 5. The cumulative effect is similar to the other alternatives and considered insignificant.

Effects on Prey Availability: TAC levels under Alternative 5 are comparable to Alternatives 1, 3, and 4 although there are slight differences among areas. The AI pollock TAC is significantly lower and more comparable to Alternative 2. A slight reduction in TAC in the BS cod fishery also exists compared to Alternatives 1, 3, and 4. Some degree of competitive interaction is expected to occur; although the degree is unknown. This alternative was rated as insignificant for this effect. Since the external and internal factors

are similar to Alternatives 1, 3 and 4, the cumulative effect of prey availability is also similar and considered insignificant.

Temporal/Spatial Concentration: Closures around Steller sea lion rookeries exist under Alternative 5; however, more global nearshore closures are absent from this alternative. Closures would benefit harbor seal where overlap occurs. The seasonal nature of the pollock closures around rookeries, however, is less protective than were they to remain in place year round. Spatial closures are minimal for the various fisheries under Alternative 5. To the extent that areas are left open for nearshore fishing for Pacific cod in the GOA, and seasonally for pollock, harbor seals are afforded less protection. Generally some large open areas exist, particularly in the Kodiak region, where fishing pressure concentrated in these areas could be problematic for the depressed harbor seal population.

Harvest limits (i.e. inside vs. outside critical habitat) and seasonal allocations of pollock, cod and Atka mackerel would improve the availability of forage for harbor seals. The temporal distribution of TAC appears to be more evenly distributed than for some of the other alternatives. To the extent that large amounts of the TAC are not removed at a specific time of the year (and in particular during the early summer months when animals are pupping and weaning their young, as well as potentially in the winter) this provides greater opportunity for prey to be available to harbor seals.

Effects of temporal/spatial concentration of harvest are not a substantial improvement over Alternative 1, and considering external effects, the cumulative effect is considered conditionally significant adverse, similar to Alternative 1.

Disturbance: Alternative 5 is not expected to cause disturbance effects any different than those already discussed under Alternative 1. Therefore, the cumulative effect is considered insignificant, similar to Alternative 1.

Table 4.13-5 Harbor Seal

Alternative 2- Past, Present, and Predicted

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events							
	Alt. 1	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift					
		0	-	0	0	0					
			-	0	0	+ / -	+ / -				
Take	I*							Y			N
Prey	I*							Y			N
Spatial/Temporal	CS+							Y	N		
Disturbance	I							Y	N		

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *Extremely negligible effect not seen at the population level; essentially no effect.

**Present and predicted effects for are the similar for all alternatives.

Other Pinnipeds

Other pinnipeds is a species group which includes a variety of marine mammals that have relatively little overlap with the groundfish fisheries but do occur in the BSAI and GOA. Species include in this group include: the ice seals (spotted, bearded, ringed, and ribbon seals), Pacific walrus, and northern elephant seal. Ecological interactions between these species and commercial groundfish fisheries are limited by both spatial separation and differences between commercial harvest targets and the species food habits.

Affected Environment Factors

Other pinnipeds is a species group which includes a variety of marine mammals that have relatively little overlap with the groundfish fisheries but do occur in the BSAI and GOA. Species include in this group include: the ice seals (spotted, bearded, ringed, and ribbon seals), Pacific walrus, and northern elephant seal. Ecological interactions between these species and commercial groundfish fisheries are limited by both spatial separation and differences between commercial harvest targets and the species food habits. Additional information on the life history and ecology of the is found in Section 3.1.6. of this SEIS and in Section 3.4.1 of the Groundfish Draft Programmatic SEIS (NMFS, 2000a)

External Factors and Consequences

Additional information on the past and present external effects on other pinnipeds is presented in Appendix J, Section 1.5 of the Groundfish Draft Programmatic SEIS (NMFS, 2000a). The Pacific walrus is the only species which has received special attention from past fisheries management actions. Round Island, is a State of Alaska Preserve; fishing regulations prohibit fishing vessels from entering within 12 miles of Round Island from April 1 to September 30.

The primary adverse effect on this species group is subsistence, except for the northern elephant seal. Most of the harvest of the ice seals is in the western Bering Sea by Russian hunters. All of the ice seals and walrus are susceptible to climate change due to their dependance on pack ice in the Bering sea.

Analysis and Significance of Cumulative Effects

Table 4.13-6 presents the results of the cumulative effects analysis in matrix form for each alternative plan. This table was developed following the approach outlined in Section 4.13. Cumulative effects are only analyzed for Alternative 1 since the effects on this group are not expected to vary across the five alternatives.

Past external adverse effects were identified for foreign fisheries in the northern Bering Sea. Subsistence harvest of ice seals and walrus has not appear to had effect at the population level. Subsistence harvest of walrus and seals by Natives hunters in the past has contributed to take of most of these species in the BSAI region, but effects have not been observed at the population level (Hill and DeMaster 1999). Lacking internal effects from the groundfish fisheries, no cumulative effect was found for incidental take/entanglement.

Past external adverse effect on prey of these species has not been identified. Present and predicted effect of the groundfish fisheries are lacking, therefore, the no cumulative effect was identified for effect on prey or temporal/spatial effects of harvest of prey species.

Present and predicted effect of the groundfish fisheries (given the general lack of spatial, temporal, or dietary overlap, disturbance effects caused by vessel traffic, noise, or fishing gear) are likely to be insignificant under all of the alternatives.

Individual animals in the pinniped group venturing into fishing areas could temporarily modify their behavior due to disturbance by fishing activities. Disturbance was found to be cumulative based on external factors, but given the very limited overlap of the groundfish with the range of these species, the cumulative effect is considered insignificant.

Table 4.13-6 Other Pinnipeds

Alternative 1 - past Influence

Category	External Effects									
	Human Controlled					Natural Events				
Direct/Indirect Effects of Groundfish Fishery	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commercial Harvest	Short-term Climate	Long-term Climate	Regime Shift	Past Influence Y/N		
Incidental Take	-	-	-	-	0	0	0			
Effects on Prey	-	-	0	0	0	+/-	+/-			
Spatial/Temporal	0	0	0	0	0	0	0			
Disturbance	-	-	-	-	0	0	0			

Alternative 1 ** - Past, Present, and Predicted

Category	External Effects									
	Human Controlled					Natural Events				
Direct/Indirect Effects of Groundfish Fishery	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate	Regime Shift
Take	0	-	0	0	0	-	-	0	0	0
Prey	-	0	0	+/-	+/-	-	0	0	0	0
Spatial/Temporal	-	0	0	0	0	-	0	0	0	0
Disturbance	-	0	0	0	0	-	-	0	0	0

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
 Notes: *Extremely negligible effect not seen at the population level; essentially no effect.

**Present and predicted effects for are the similar for all alternatives.

Sea Otters

Affected Environment Factors

The sea otter population in Alaska is neither listed as threatened or endangered under the ESA nor as depleted under the Marine Mammal Protection Agency. Additional details concerning the life history, management and population ecology is provided in Section 3.17 of this document, and Section 3.4.2 of the Groundfish Draft Programmatic SEIS (NMFS 2001).

The sea otter inhabits shallow coastal waters of the North Pacific Ocean and the southern Bering Sea (Estes, 1980; Estes and Van Blaricom, 1985; Estes and Palmisano, 1974). Habitat is generally shallow (less than 131 feet--40 m) nearshore marine waters with sandy or rocky bottoms supporting substantial populations of benthic invertebrates (Bodkin and Udevitz, 1999). In some areas, large numbers of sea otters occur offshore. For example, in the Copper River Delta and inside Prince William Sound, sea otters are often present more than 5 miles (8 km) from shore (Garshelis and Garshelis, 1984). Large aggregations have been observed more than 18.6 miles (30 km) north of Unimak Island in the Bering Sea (Kenyon, 1969).

The sea otter's diet consists of an estimated 82% invertebrates and 18% fish (Kenyon, 1969, 1981; Lowry *et al.*, 1982). The fish component included lumpsuckers, sculpin, rock greenling, Atka mackerel, rockfish, sablefish, Pacific cod, and pollock. Based on this inshore range of the sea otter and the limited overlap in prey species, there is minimal overlap occurs between the sea otter population and the groundfish fisheries.

External Factors and Consequences

Past internal and external effects are excerpted from Appendix J, Section 1.6 of the Groundfish Draft Programmatic SEIS (NMFS, 2001a). Numerous fishery management actions have been implemented that affect marine mammals, but there have been no direct actions taken to address sea otters. Sea otters are managed by the U.S. Fish and Wildlife Service (USFWS) and are primarily found in relatively shallow water.

Past effects with residual impacts on current populations of sea otters include the early commercial take of otters and pollution events such as the Exxon Valdez Oil Spill (EVOS). The numbers of otters killed in that spill ranged into the low thousands (Estes *et al.* 1998). Sea otter interactions with fishing gear, either passive or active are infrequent (Laist 1997). Incidental take in the groundfish trawl, longline, and pot fisheries during 1990–1995 was very low ranging from zero to two animals per year. Interactions with groundfish fisheries were observed only in the BSAI pot fishery. The total take/entanglement for the sea otter is considered to be insignificant (*i.e.*, less than 10 percent of the calculated potential biological removal [PBR]). None of the alternatives would be expected to alter these patterns.

As shown in Table 4.13-7, early commercial harvests were found to have had a negative impact on sea otters dating from the mid-1700s. Commercial exploitation for pelts from this time to the late 1800s caused sea otters to nearly become extinct (Bancroft 1959, Lensink 1962). Protective measures instituted in this century have allowed remnant groups to increase and reoccupy much of the historic sea otter range in Alaska (Kenyon 1969, Estes 1980). Residual effects from this early harvest likely persist in several areas. The Alaskan sea otter population has been experiencing severe declines in the central portion of its range in recent years, but the causes of the decline are not fully understood (Estes *et al.* 1998). The USFWS has proposed that the Aleutian Islands population be listed as a depleted species (November 2000).

As depicted in Table 4.13-7, the present and predicted external effects on sea otters include other fisheries, subsistence, pollution, and natural factors. Commercial harvest of sea otters is no longer conducted and the effects of foreign and joint venture fisheries are no longer a factor in sea otter mortality.

Present and predicted external factors that contribute to overall take of sea otters include the subsistence harvest which is approximately 686 animals per year (1996 to 2000) and natural events such as climate change or increased predation from killer whales, hypothesized to be a result of decreased availability of sea lions to killer whales (Estes et al. 1998). Take of sea otters is not found to be a cumulative effect since the contribution of the groundfish fisheries is extremely small.

Analysis and Significance of Cumulative Effects

As summarized in Table 4.13-7, cumulative effects are not expected under all alternatives for the four categories of direct/indirect effects: incidental take/entanglement, effect on prey, spatial/temporal effects, and disturbance.

Incidental take/entanglement was the only past influence which was found to have been a lingering major effect. Present interactions between sea otter and groundfish fisheries were observed only in the BSAI pot fishery. The total take/entanglement for the sea otter is considered to be insignificant (i.e., less than 10 percent of the calculated potential biological removal [PBR]). None of the alternatives would be expected to alter these patterns.

Past effects on prey availability are not fully understood, but the overlap between prey species of the sea otter and the groundfish fisheries is low. The near shore distribution of most sea otters and their benthic feeding habits limit the effects of the fishery on prey availability, and this effect is determined to be insignificant under all alternatives. Because of this negligible effect from the groundfish fishery, the effect on prey availability is not found to be cumulative.

Competition for forage between sea otters and commercial fisheries rarely occurs, despite the species geographical distribution in the Gulf of Alaska and the Aleutian Islands. Since their primary prey items are found on the bottom in the littoral zone, to depths of 164 feet (50 m), the majority of otters feed within 0.6 miles (1 km) of the shore (Kenyon 1968a). Because of this habitat preference for shallow areas, they do not overlap spatially with groundfish fisheries. The effects are insignificant for all alternatives. Because of the lack of direct and indirect effect from the groundfish fishery, effect were not found to be cumulative.

Disturbance of sea otters is generally not considered to be an issue of concern in that otters do not appear to be adversely affected by human activity. The effect of disturbance is considered insignificant under all alternatives. The very limited overlap between the groundfish fisheries and sea otters indicates that the effect of disturbance on sea otter population is not cumulative.

Table 4.13-7 Sea Otter

Alternative 1 - past influence

Category	External Effects									
	Human Controlled									
Direct/Indirect Effects of Groundfish Fishery	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Commercial Harvest	Short-term Climate	Long-term Climate	Regime Shift			
Take	-	-	-	-	0	0	0	Y		
Prey	0	0	0	0	0	+/-	+/-	N		
Spatial/Temporal	0	0	0	0	0	0	0	N		
Disturbance	0	-	-	-	0	0	0	N		

Alternative 1** - Past, Present, and Predicted

Category	Rating	External Effects									
		Human Events					Natural Events				
	Alt. 1	Other Fisheries	Subsistence Harvest	Pollution	Short-term Climate	Long-term Climate	Regime Shift				Conditionally Significant Y/N
Take	I*	-	-	-	0	0	0	N			
Prey	I*	-	0	0	0	+/-	+/-	N			
Spatial/Temporal	I*	0	0	0	0	0	0	N			
Disturbance	I*	0	0	0	0	0	0	N			

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *Effect is extremely negligible; essentially no effect.

** Present and Predicted for Alternative 2-5 same as Alternative 1

4.13.2 Target Groundfish Species and Other Species

4.13.2.1 Summary of Affected Environment Factors

The major target groundfish species considered in this analysis include: pollock, Pacific cod, and Atka mackerel. These species are principally affected by the proposed SSL protection measures and are considered individually in this analysis. The cumulative effect analysis for the remaining target groundfish and other species has been grouped as follows: the flatfish complex (including Greenland turbot, arrowtooth flounder, flathead sole, rock sole, and other flatfish); Pacific Ocean perch (POP) and other rockfish; thornyheads; sablefish; and other species (squid, skates, sharks, sculpin, and octopus). The cumulative effect analysis for these remaining species has been simplified because the proposed SSL protection measures do not change their management significantly from current management measures, and the results of the direct and indirect effects analysis for the grouped species are essentially the same (see Section 4.2). Descriptions of the major target groundfish species are provided in Section 3.2, including summaries of important life history traits and habitat, trophic interactions, the fishery, and stock assessment and status of the stocks. Detailed information on the remaining target species is provided in Section 3.3 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

Direct and indirect impacts of the alternatives on all target groundfish species and other species are evaluated in Section 4.2. Two direct and two indirect effects are considered for each target groundfish species or species group:

Direct Effects: Fishing Mortality
 Spatial/Temporal Concentration of the Catch

Indirect Effects: Prey Availability
 Habitat Suitability

Direct and indirect effects on target groundfish species are rated for the no action alternative (Alternative 1) and the proposed SSL protection measures (Alternatives 2 through 5) independently. The alternatives are described in detail in Section 2.3. The rating criteria and the results of this analysis are presented in Section 4.2.

4.13.2.2 Summary of External Factors and Consequences

As described in the introduction to Section 4.13, the cumulative effect analysis must take into consideration actions that are external, as well as internal, to the groundfish fisheries. The majority of past external effects, and many of the present and predicted effects evaluated in the cumulative effect analysis in this SEIS have been examined in the cumulative effect analysis in the Groundfish Draft Programmatic SEIS (Appendix J of NMFS 2001a). There are few cases where past external effects and present or predicted external effects for this analysis are expected to be different from the Groundfish Draft Programmatic SEIS. A discussion of the external effects screened for cumulative effect analyses is presented in Section 4.13. These effects must include both past effects that have a lingering influence (past influence), present, and predicted future external effects. The external effects determined to be applicable to the target groundfish species and other species cumulative effects analyses include the following:

Past External Effects

- Foreign Fisheries
- Other Fisheries - Joint Venture (JV) and Domestic groundfish fisheries, State of Alaska managed fisheries, the International Pacific Halibut Commission (IPHC) managed halibut fishery
- Subsistence Fisheries
- Seal Harvesting
- Whaling
- Pollution - includes effects from the Exxon Valdez oil spill (EVOS)
- Climate Effects - short-term and long-term climate variability, climate change, and ecological regime shifts.

See the introduction to Section 4.13 for description of individual effects categories.

Present and Predicted Future Effects

- Other Fisheries - State of Alaska (state) managed fisheries (e.g., scallop, flatfish, sablefish, Pacific cod, herring roe and bait fishery, and crab pot fishery), the IPHC managed halibut fishery, and sport fisheries (halibut and salmon).
- Subsistence Fisheries
- Climate Effects - short-term and long-term climate variability, climate change, and ecological regime shifts.

Not all of the external effects identified above are pertinent to all target groundfish species or other species. Discussions focusing on individual species or species groups follow and include information concerning external factors that are specific to the species or group.

4.13.2.3 Summary of Cumulative Effects

The following subsections provide information concerning the specific affected environment factors, and past, present, and predicted external factors and consequences, and analyze the cumulative effects for each of the target species considered in this SEIS: walleye pollock, pacific cod, flatfish, rockfish, thornyheads, sablefish, and squid and other species.

Walleye Pollock

A summary of the cumulative effects analysis for walleye pollock in the eastern Bering Sea (EBS) and Aleutian Islands is presented in Table 4.13-8. The results of the cumulative effects analysis for EBS pollock are expected to be similar for Aleutian Islands pollock, given the similar findings of the direct and indirect effects analysis (see Section 4.2.2). The cumulative effects analysis for the Gulf of Alaska (GOA) stock of walleye pollock is presented in Table 4.13-9. Each table includes separate matrices describing past external effects (including past effects that continue to influence the stock), ratings for the no action alternative (Alternative 1) and Alternatives 2 through 5, and present and predicted future external effects. Table development, rating scales, and rating criteria are described in Section 4.13.

Affected Environment Factors

As described in Section 3.2.1 of this SEIS, Walleye pollock is the most abundant groundfish species in the eastern Bering Sea and the second most abundant groundfish stock in the GOA. It is known to be a major prey item of Steller sea lions. Additional information regarding stock description, life history, trophic interactions and the pollock fishery can be found in Section 3.6.1 of this SEIS.

Numerous fishery management actions have been implemented that affect the pollock fisheries in the EBS and GOA. These actions have been described in more detail in Sections, 2.4.1, 2.7, and 4.13.2 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

External Factors and Consequences

Pollock were historically the target of foreign and JV fisheries throughout the BSAI and to a lesser extent in the GOA. The EBS stock is believed to have been overfished by the Soviet fleet in the 1970s, and heavily exploited by foreign and JV fisheries in the 1980s. Both stocks currently exhibit the age structures of populations that have been fished for long periods of time (Ianelli et al. 2000, see Section 3.2.1). As shown on Tables 4.13-8 and 4.13-9, foreign and JV fisheries are found to have had a negative impact on pollock due to fishing mortality in both the EBS and the GOA. In the GOA, past bycatch of pollock in the shrimp fishery is also identified as an additional adverse effect, although this effect is expected to be minimal in comparison to the influence of the directed fisheries. The effect of these fisheries on spatial/temporal concentration of the pollock catch is unknown for both the EBS and GOA. Past effects from the shrimp fishery include potentially negative effects from competition for shrimp as prey for adult pollock, and a beneficial effect from reductions in prey competition between shrimp and larval pollock.

In the BSAI, past seal harvests are identified as being a positive beneficial effect on pollock mortality because studies suggest that pollock is a primary prey item of northern fur seals and harbor seals (see Sections 3.1.4 and 3.1.5). Pollock are also one of the most common prey in the diet of spotted seals and ribbon seals, which feed on pollock in the winter and spring in the areas of drifting ice (Lowry et al. 1997, see Section 3.1.6). Whaling is identified as having a past beneficial effect on mortality for both EBS and GOA pollock stocks. Pollock has been noted as a prey item for fin whales, minke whales, and humpback whales (see Section 3.1.2). Historic removal of the large predators may have favored recruitment of larval and juvenile pollock in the past. The cessation of seal and whale harvests in the BSAI is judged to have had a negative effect on pollock recruitment as these populations of marine mammals have rebounded.

The effects of pollution on GOA pollock stocks from the Exxon Valdez Oil Spill is unknown as far as direct mortality and concentration of the fishery are concerned. However, the event has been identified as having a past adverse effect on spawning habitat and prey availability.

The effects of climate variability and ecological regime shifts are identified as having potentially positive or negative effects on habitat suitability and prey availability for pollock. Observations of ecological responses in the BSAI and GOA indicate that changes in water temperatures and current regimes following an observed climatic shift in the late 1970s have favored the recruitment and survival of gaddids (pollock and cod) and flatfish, shifting dominance away from non-groundfish species. As noted in Section 4.13.1, prior to 1978 shrimp and other non-groundfish species tended to dominate catches in the EBS and GOA in terms of overall biomass. Following the observed changes in climate, the total catch biomass has been increasingly dominated by gaddids and flatfish.

Analysis and Significance of Cumulative Effects

The cumulative effect analysis for walleye pollock in the EBS and GOA under the no action alternative (Alternative 1) and the SSL protection alternatives (Alternatives 2 through 5) are presented in the second matrices of Tables 4.13-8 and 4.13-9, respectively. These matrices include a summary of direct and indirect effects of the groundfish fisheries, external effects and cumulative effects for each alternative. External effects and cumulative effects are described in more detail below. The analyses direct and indirect effects under the alternatives are described in detail in Section 4.2.2.

Foreign and JV fisheries, and shrimp fisheries no longer occur and are not a concern. Commercial whale and seal harvests also no longer occur. Seals and some whale species are currently taken by subsistence hunters and will be in the future, but the level of subsistence harvest is not expected to be a significant external effect (see Section 4.13.1). For pollock in the BSAI, the Russian fishery that occurs in the western Bering Sea has been identified as an external effect that could result in increased fishing mortality. Similarly, the State of Alaska groundfish fisheries in the GOA are identified as a present and future source of fishing mortality (see the introduction to Section 4.13). However, the magnitude of both of these external effects is likely to be minor for all alternatives. Climate and ecological regime shifts are expected to occur periodically for the foreseeable future. As noted in Section 4.13, these shifts can have positive, negative, or possibly neutral effects on the recruitment and survival of fish species. Accordingly, pollock stocks may shift positively or negatively in abundance in response to future climate and regime effects. These effects in combination with intensive harvest pressure in historic fisheries have not threatened either stocks' ability to remain above MSST. Given the fact that pollock stocks have persisted despite these effects, climate moderated effects are not predicted to threaten either stocks' ability to remain above MSST in the foreseeable future.

Cumulative effects under Alternatives 1 through 5 are described below and ratings are presented in Tables 4.13-8 and 4.13-9:

- **Fishing Mortality:** Historic fishing mortality from human and non-human sources is identified as an external effect with lingering past adverse impacts on both EBS and GOA pollock stocks. As described in Section 4.2.1, the fishing mortality for all alternatives is rated as insignificant because the over fishing limit (OFL) of the stocks is not reached in any case. The direct and indirect effects of each of the alternatives, in combination with lingering past effects and external effects on fishing mortality, are judged to have a combined cumulative effect on pollock fishing mortality in each case. However, pollock stocks have persisted at relatively robust levels despite high historic harvest levels and documented climate driven effects on marine ecosystems. The cumulative effects of fishing mortality and external effects are judged to be of insufficient in magnitude to result in harvest levels that approach or exceed the OFL threshold under any alternative. Therefore, the identified cumulative effects of all alternatives are judged to be insignificant.
- **Spatial/Temporal Concentration of Fishery:** No lingering past influence or current direct or indirect effects from spatial and temporal concentration of catch are identified under any alternative for either stock (see Section 4.2.1). Therefore, there is no finding of cumulative effects for any alternative. Although past external actions that likely affected the stocks are identified, specifically the intensive JV and foreign fisheries, the effects are not observable in the distribution of the present populations which are at high levels (NMFS 2001a Appendix J).
- **Habitat Suitability:** A past influence of external effects on habitat suitability is not found for the GOA pollock stock. Although past external actions that likely affected the stocks in the GOA are identified, these effects have not lingered and are generally not observable in the present populations (NMFS 2001a Appendix J). The EBS stock showed lingering positive effects from the regime shift associated with climate variability in the late 1970s, which created conditions favorable for stock recruitment and a succession of large year classes (see Section 4.13.3).

Natural events related to climate change are identified as contributing to a cumulative effect for both the EBS and GOA stocks. Ecological regime shifts associated with climate variability have occurred in the past and are likely to occur again in the foreseeable future. However, these effects have not proven to be of sufficient magnitude to jeopardize the ability either to sustain itself above MSST, and are judged unlikely to do so in the future. Therefore, while a cumulative effect is identified for each alternative, any effects are rated as insignificant.

- **Prey Availability:** Lingering past influences on prey availability are identified for both the EBS and GOA stocks (see Tables 4.13-8 and 4.13-9). In general, these effects have been beneficial, however they are judged collectively to be insignificant (Section 4.2.1). Given the presence of past effects on prey availability, as well as the probability of future climate driven effects, a cumulative effect on prey availability has been identified for each alternative. However, the cumulative effects of each alternative on prey availability in combination with the influence of external factors are judged to be of insufficient magnitude to jeopardize ability of either pollock stock to remain above MSST in any case. Therefore the cumulative effect of each alternative on prey availability is judged to be insignificant for both pollock stocks.

Table 4.13-8 Summary of Cumulative Effect Analysis for Eastern Bering Sea Pollock

Past Effects

Category	Past External Effects					Lingering Past Influence? Y/N
	Foreign Fisheries	JV	Seal Harvest	Whaling	Natural Events	
Fishing Mortality	-	-	+	+	0	Y
Spatial Temporal Conc.	U	U	0	0	0	N
Habitat Suitability	0	0	0	0	+/-	Y
Prey Availability	+	+	0	+	+/-	Y

Alternatives 1 through 5

Category	Direct/Indirect Effects of the Groundfish Fishing			Rating
	Human Controlled	Russian Fishing	Natural Events	
Fishing Mortality	-	-	0	I
Spatial Temporal Conc.	0	0	0	I
Habitat Suitability	0	0	+/-	I
Prey Availability	0	0	+/-	I

External Effects		Lingering Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Human Controlled	Natural Events			
Russian Fishing	Climate and Regime Shifts			
-	0	Y	Y	N
0	0	N	N	
0	+/-	Y	Y	N
0	+/-	Y	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-9 Summary of Cumulative Effect Analysis for Gulf of Alaska Pollock

Past Effects

Category	Past External Effects						Lingering Past Influence? Y/N
	Human Controlled				Natural Events		
	Foreign Fisheries	JV	Shrimp Fishery	Whaling	Pollution (EVOS)	Climate and Regime Shifts	
Fishing Mortality	-	-	-	+	U	0	Y
Spatial temporal conc.	U	U	U	0	U	0	N
Habitat Suitability	U	0	0	0	-	+/-	N
Prey Availability	+	+	+/-	+	-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of the Groundfish Fishing		Rating	Present and Predicted Future External Effects				Lingering Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category			Human Controlled		Natural Events				
			State Fishery		Climate and Regime Shifts				
Fishing Mortality	I	I	-*		0		Y	Y	N
Spatial temporal conc.	I	I	0		0		N	N	
Habitat Suitability	I	I	0		+/-		N	Y	N
Prey Availability	I	I	0		+/-		Y	Y	N

*very minor

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Pacific Cod

Ratings for past external, direct and indirect effects of Alternatives 1 through 5, present and predicted future external effects, and cumulative effects on Pacific cod in the BSAI for Alternatives 1 through 5 are presented in Table 4.13-10; ratings for the GOA stock of Pacific cod are shown in Table 4.13-11. The tables were developed following the approach outlined in Section 4.13.

Affected Environment Factors

Pacific cod is a demersal species that occurs on the continental shelf and upper slope through the GOA, Aleutian islands, and eastern Bering Sea to Norton Sound. Tagging studies show that cod migrate seasonally over large areas. Additional information concerning stock description, life history, trophic interactions and the fishery are provided in section 3.2.2 of this document.

Numerous fishery management actions have been implemented that affect the Pacific cod fisheries in the BSAI and GOA. These actions are described in more detail in Sections, 2.4.1, 2.7, and 4.13.2 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

External Factors and Consequences

Fishing mortality from past foreign, JV, and halibut longline fisheries are found to have had a lingering negative influence on both the BSAI and the GOA cod stocks (Tables 4.13-3 and 4.13-4). In past crab fisheries, Pacific cod were captured as bycatch and used in the fishery as bait. These removals are judged to have had a negative effect on both BSAI and GOA stocks. However, relative to directed fisheries this effect is believed to be of minor significance. An expanding State of Alaska fishery directed on the GOA stock is also judged to have had negative effects both in the past and in the foreseeable future.

The direct foreign, JV, and halibut longline fisheries are thought to have had no observable effect on the spatial temporal concentration of the catch in both the BSAI and GOA stocks. The State of Alaska fishery in the GOA is spatially and temporally concentrated in within the three mile coastal limit, and this concentration is believed to have had a negative effect on this stock. This negative effect has had a lingering population level influence.

Habitat suitability for both stocks has been negatively affected by the intensity of the past foreign and JV fisheries. However, the effects are not considered to have lingering influence at the population level (NMFS 2001a Appendix J).

All four past fisheries (foreign, JV, halibut, and crab) in the BSAI, and five (foreign, JV, halibut, crab, and State directed) in the GOA, have had a lingering negative impact on prey availability through removal of groundfish prey for adult cod. Small Pacific cod feed mostly on invertebrates, while large Pacific cod are mainly piscivorous. They consume pollock ranging in age from age-0 to greater than age-6 depending on predator size (see Section 3.2.1). Past removals of pollock in past foreign and JV fisheries in the BSAI and GOA have been extensive. The current pollock fishery also removes a significant proportion of the prey base. This negative impact can be expected to continue for the foreseeable future.

The effects of climate variability and ecological regime shifts are identified as having potentially positive or negative effects on habitat suitability and prey availability for Pacific cod. Observations of ecological responses in the BSAI and GOA indicate that changes in water temperatures and current regimes following an observed climatic shift in the late 1970s have favored the recruitment and survival of gaddids (pollock and cod) and flatfish, shifting dominance away from non-groundfish species. As noted in Section 4.13, prior to 1978 shrimp and other non-groundfish species tended to dominate catches in the EBS and GOA in terms of

overall biomass. Following the observed changes in climate, the total catch biomass has been increasingly dominated by gaddids and flatfish.

Analysis and Significance of Cumulative Effects

The cumulative effects analyses for Pacific cod in the BSAI and GOA under the no action alternative (Alternative 1) and Alternatives 2 through 5 are presented in the second matrices of Tables 4.13-10 and 4.13-11, respectively. These matrices include a summary of direct and indirect effects of the groundfish fishery, ratings for the alternatives, present and predicted future external effects, and cumulative effects. The analysis of direct and indirect effects under the no action alternative are described in detail in Section 4.2.3. External effects are the same as described above for past effects, with the exception that foreign and JV fisheries are no longer conducted and are not a concern. The analysis of cumulative effects is described below.

Cumulative effects under Alternatives 1 through 5 are described below and ratings are presented in Tables 4.13-10 and 4.13-11:

- **Fishing Mortality:** A past adverse influence of external effects as described above is identified for fishing mortality in both the BSAI and GOA Pacific cod stocks. As described in Section 4.2.2, the effect of fishing mortality on both stocks is rated insignificant for all alternatives because the OFL of the stocks is not reached in any case. Cod harvest under Alternatives 1 through 5, in combination with lingering past effects on fishing mortality, and external effects from halibut longline, crab (direct and bait), and State Pacific cod fisheries (GOA only) contribute to the finding of a cumulative effect under all alternatives. In each case however, these combined influences are insufficient in magnitude to push the fishing mortality close to the OFL threshold. Therefore, cumulative effects for all alternatives are rated as insignificant for both BSAI and GOA stocks because OFL is not expected to be reached in any case, even with the additional adverse influence of the external factors. Model projections for all alternatives indicate that female spawning biomass dips below the B_{msy} for both stocks between 2002 and 2005 under Alternatives 1, 3, 4, and 5, but then climbs above B_{msy} in 2006. Spawning biomass remains above B_{msy} for both stocks in all projected years under Alternative 2.
- **Spatial and Temporal Concentration of Catch:** A lingering past influence of external effects on spatial temporal concentration of the fishery is not identified for the BSAI stock, but is noted for the GOA stock. Direct and indirect effects on both stocks are rated as insignificant under all alternatives. No existing external effects are identified for the BSAI stock so no cumulative effect is identified. The lingering negative effects of the State fishery on the GOA stock contributes to the finding of cumulative effects. However, this lingering effect is insufficient in magnitude to jeopardize the stocks ability to sustain itself above MSST under any of the alternatives. Therefore, cumulative effects on spatial and temporal concentration of catch are judged to be insignificant under all alternatives for both stocks.
- **Habitat Suitability:** A lingering past influence of external effects on habitat suitability is identified for both Pacific cod stocks. The climate and regime shift of the late 1970s favorably influenced conditions for cod and other gaddids. However, it was determined that the effects of these improved conditions are not observable in the present populations (NMFS 2001a Appendix J). The foreign and JV fisheries did have negative impacts on habitat suitability which linger to the present. The direct and indirect effects of Alternatives 1 through 5 on habitat suitability are insignificant. These effects, in combination with lingering past influences and the potential for natural events related to climate change and variability contributing to a finding of a cumulative effect for both stocks. However, these effects are of insufficient magnitude to push either stock below MSST. Therefore, the cumulative effect on each stock under all alternatives is rated as insignificant.

- **Prey Availability:** Lingering past influences on prey availability from foreign and domestic fisheries, and climate variability and related ecological regime shifts are identified for both the BSAI and GOA Pacific cod stocks. The direct and indirect effects of Alternatives 1 through 5 on prey availability were found to be insignificant for both stocks in every case. While both human controlled and natural factors are identified as potentially affecting prey availability in the future, these effects in combination with lingering past influences are judged to be of insufficient magnitude to affect the ability of the stock to sustain itself above MSST under any alternative. Therefore, while a cumulative effect is identified for each stock under every alternative, these effects are judged to be insignificant.

Table 4.13-10 Summary of cumulative effect analysis for BSAI Pacific cod

Past Effects

Category	Past External Effects					Past Lingering Influence? Y/N
	Human Controlled				Natural Events	
	Foreign Fisheries	JV	Halibut Longline	Crab (bycatch and bait)	Climate and Regime Shifts	
Fishing Mortality	-	-	-	-	0	Y
Spatial Temporal Conc.	0	0	0	0	0	N
Habitat Suitability	-	-	0	0	+/-	Y
Prey Availability	-	-	-	-	+/-	Y

Alternatives 1 through 5

Category	Present and Predicted Future External Effects					Past Lingering Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
	Human Controlled				Natural Events			
	Halibut Longline	Crab (direct and bait)	Crab (bycatch and bait)	Climate and Regime Shifts	Climate and Regime Shifts			
Fishing Mortality	-	-	-	0	0	Y	Y	N
Spatial Temporal Conc.	0	0	0	0	0	N	N	
Habitat Suitability	0	0	0	+/-	+/-	Y	Y	N
Prey Availability	-	-	-	+/-	+/-	Y	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-11 Summary of cumulative effect analysis for GOA Pacific cod

Past Effects

Category	Past External Effects						Past Lingering Influence? Y/N
	Human Controlled					Natural Events	
	Foreign Fisheries	JV	Halibut Longline	Crab (bycatch and bait)	State Fishery	Climate and Regime Shifts	
Fishing Mortality	-	-	-	-	-	0	Y
Spatial Temporal Conc.	0	0	0	0	-	0	Y
Habitat Suitability	-	-	0	0	0	+/-	Y
Prey Availability	-	-	-	-	-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Present and Predicted Future External Effects						Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events				
		Halibut Longline	Crab (direct and bait)	State Fishery	Climate and Regime Shifts				
Fishing Mortality	NS	-	-	-	0	Y	Y	N	
Spatial Temporal Conc.	NS	0	0	0	0	Y	N	N	
Habitat Suitability	NS	0	0	0	+/-	Y	Y	N	
Prey Availability	NS	-	-	-	+/-	Y	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.2.4 Atka Mackerel

Ratings for cumulative effects on Atka mackerel in the BSAI and GOA under the no action alternative (Alternative 1) and the SSL protection measures (Alternatives 2 through 5) are described below. Cumulative effects ratings summaries for the BSAI Atka mackerel stock are presented in Table 4.13-12. Ratings for the GOA stock of Atka mackerel are shown in Table 4.13-13. The tables were developed following the approach outlined in Section 4.13.

Affected Environment Factors

Numerous fishery management actions have been implemented that affect the Atka mackerel fisheries in the BSAI and GOA. These actions are summarized in Section 3.2 and are described in more detail in Sections, 2.4.1, 2.7, and 4.13.3 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

Past Internal and External Effects

Past foreign and JV fisheries are found to have had a negative impact on the BSAI and GOA Atka mackerel stocks (see Tables 4.13-12 and 4.13-13). These impacts are judged to have had a lingering population level effect on the GOA stock, which underwent precipitous declines while being prosecuted by a large foreign fishery. The fishery impacts were exacerbated by the apparent dependence of the population on recruitment of juveniles from the BSAI (Section 3.2.3). There is no past influence of external effects on fishing mortality or spatial temporal concentration in the BSAI stock (NMFS 2001a Appendix J). The effect of these fisheries on habitat suitability for both stocks is unknown.

Whaling is identified as having a past beneficial effect on prey availability for both the BSAI and GOA Atka mackerel stocks, as whales compete for an overlapping suite of invertebrate prey. Climate variability and resulting ecological regime shifts are identified as having potentially positive or negative effects on habitat suitability and prey availability in both stocks. In general, a shift toward colder waters favors recruitment and survival of Atka mackerel. When the Aleutian Low was strong during the period from the late 1970s to the mid 1990s, water temperatures were higher, and biomass in the catches was dominated by cod, pollock, and flatfishes. Catches of Atka mackerel in the GOA declined significantly over this period. The western GOA is at the range limit of Atka mackerel, and this population is believed to be supported primarily by recruitment of juveniles from the BSAI stock during strong brood years (see Section 3.2.3). Community structure in nearshore areas around Kodiak Island changed in this same period, with decreasing populations of shrimps and small forage fish, and increasing populations of large, fish-eating species, such as Pacific cod, and flatfishes (see Section 4.13.2.3).

Cumulative Effects of Alternatives 1 through 5

Present and Predicted Future External Effects

External effects associated with Alternatives 1 through 5 are depicted on Tables 4.13-12 and 4.13-13. Because Atka mackerel are not commonly caught as bycatch in other directed fisheries (see Section 3.2.3), the only external factors considered under any of the alternatives consist of the natural events associated with climate change and ecological regime shifts. Ecological regime shifts can have positive, negative, or neutral effects on Atka mackerel recruitment and survival, and these effects are associated with cumulative effects via prey availability and habitat suitability.

Cumulative Effects

Cumulative effects under Alternatives 1 through 5 are described below and ratings are presented in Tables 4.13-12 and 4.13-13. These matrices include a summary of direct and indirect effects of the groundfish fishery, ratings for the alternatives, present and predicted future external effects, and cumulative effects. The analysis of direct and indirect effects under the no action alternative are described in detail in Section 4.2.4. External effects are the same as described above for past effects, with the exception that foreign and JV fisheries are no longer conducted and are not a concern. The analysis of cumulative effects is described below.

- **Fishing Mortality:** Present and future external effects on fishing mortality are not expected for either the BSAI or GOA stocks of Atka mackerel. Cumulative effects are identified for the GOA stock due to the lingering past influence of fishing mortality for all alternatives. As described in Section 4.2.3, the rating for fishing mortality in this stock under any of the alternative is unknown because OFL for the stock is unknown (there is currently no directed fishery for Atka mackerel in the GOA, fishing mortality would occur as a result of bycatch in other fisheries). Therefore the significance of the cumulative effect of fishing mortality under all of the alternatives in combination with past fishing mortality is unknown. For the BSAI stock, fishing mortality is rated as insignificant under all alternatives because the OFL of the stock is not exceeded in any case. As there is no lingering past influence of fishing mortality on the BSAI stock, there is no cumulative effect identified in any case.
- **Spatial and Temporal Concentration of Catch:** A past influence of external effects on spatial temporal concentration of the fishery is not found for the BSAI stock, but is noted for the GOA. As noted in Section 4.2.3, the GOA stock declined steeply in abundance while being prosecuted by an intensive foreign fishery in the 1980s. There is no directed fishery on the GOA stock currently, and the impacts of this effects category would be a function of Atka mackerel bycatch in other fisheries (see Section 4.2.3). The effect of current spatial and temporal concentration of bycatch rates on the GOA stock is rated as unknown because MSST for the stock is unknown. Due to the lingering past influence of this effect category on the GOA stock, a cumulative effect is identified for all alternatives but due to lack of information about the stock the significance in each case is rated as unknown. For the BSAI stock, the effect of spatial and temporal distribution of catch is rated as insignificant under all alternatives because the stocks stock's ability to sustain itself above MSST is not jeopardized in any case. Due to the lack of past lingering influence and insignificant current effects on spatial and temporal concentration of catch, there is no cumulative effect identified for the BSAI stock under any of the alternatives.
- **Habitat Suitability:** A lingering past influence of external effects on habitat suitability is noted for the GOA stock of Atka mackerel. Specifically, the GOA is on the margin of the range for Atka mackerel, and shifting environmental conditions attributable to climate variability may have made conditions less favorable for the species in this marginal habitat. This factor, in combination with the lack of information regarding the stock leads to identification of a cumulative effect under each alternative. The MSST of the GOA stock is unknown, therefore the significance of cumulative effects is not easily rated. The potential is noted for positive or negative cumulative effects on habitat suitability and prey availability for this stock from favorable ecological regime shifts in response to climate variability (see Section 3.2.3). However, the level of significance of these effects is rated as unknown due to lack of information on this stock. A lingering past influence of external effects on the BSAI stock is noted and a cumulative effect is identified for habitat suitability under each alternative, again attributed to climate driven regime shift effects. However, the cumulative effects were rated as insignificant in every case, because the BSAI stock of Atka mackerel has remained well above MSST despite increased harvest pressure and shifting environmental conditions.

- **Prey Availability:** A lingering past influence of external effects from commercial whaling and climate variability and ecological regime shifts on prey availability is noted for the GOA stock of Atka mackerel. This factor, in combination with the lack of information regarding the stock leads to identification of a cumulative effect under each alternative. The cumulative effect on prey availability for this stock is rated as unknown in each case because information on the stock is limited and MSST is unknown. Similarly, a lingering past influence on the BSAI stock is noted and a cumulative effect is identified for prey availability under each alternative. However, the cumulative effects were rated as insignificant in every case. The BSAI stock of Atka mackerel is currently well above MSST.

Table 4.13-12 Summary of Cumulative Effect Analysis for Eastern Bering Sea/Aleutian Islands Atka Mackerel

Past Effects

Category	Past External Effects				Past Influence? Y/N
	Human Controlled		Natural Events		
	Foreign Fisheries	JV	Whaling	Climate and Regime Shifts	
Fishing Mortality	-	-	0	0	N
Spatial Temporal Conc.	-	-	0	0	N
Habitat Suitability	U	U	0	+/-	Y
Prey Availability	0	0	+	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Rating
Fishing Mortality	NS	NS
Spatial Temporal Conc.	NS	NS
Habitat Suitability	NS	NS
Prey Availability	NS	NS

Present and Predicted Future External Effects		Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Natural Events	Climate and Regime Shifts			
0	0	N	N	
0	0	N	N	
+/-	+/-	Y	Y	N*
+/-	+/-	Y	Y	N*

*Stock is presently well above MSST

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-13 Summary of Cumulative Effect Analysis for Atka Mackerel GOA

Past Effects

Category	Past External Effects				Past Influence? Y/N
	Human Controlled		Natural Events		
	Foreign Fisheries	JV	Whaling	Climate and Regime Shifts	
Fishing Mortality	-	-	0	0	Y
Spatial temporal conc.	-	-	0	0	Y
Habitat Suitability	U	U	0	+/-	Y
Prey Availability	0	0	+	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Rating	Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category					
Fishing Mortality		U	Y	Y	U
Spatial temporal conc.		U	Y	Y	U
Habitat Suitability		U	Y	Y	U
Prey Availability		U	Y	Y	U

Present and Predicted Future External Effects		Past Influence Y/N
Natural Events		
Climate and Regime Shifts		
0		Y
0		Y
+/-		Y
+/-		Y

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.2.5 Other Target Species

Flatfish

Following the organization of the direct and indirect effects analysis (see Section 4.2.5.1), the cumulative effects analysis for the various flatfish species have been grouped where the results are similar. The results of the cumulative effect analysis for yellowfin sole, rock sole, Greenland turbot, flathead sole, arrowtooth flounder, and Alaska plaice in the BSAI, and arrowtooth flounder in the GOA are summarized in Table 4.13-14. The results of the analysis for other flatfish in the BSAI, and shallow water flatfish, deepwater flatfish, rex sole and flathead sole in the GOA are summarized in Table 4.13-15. This second group of species is generally less well known than the first group, and a greater degree of uncertainty exists in the characterization of cumulative effects.

Affected Environment Factors

Several species of flatfish occur in the BSAI and GOA and are currently targeted in the Alaska groundfish fisheries. Flatfish species are by nature demersal and frequent variable habitat types depending on species. None of the species are directly affected by the proposed management changes under the alternatives. However, the fisheries may be impacted by management changes for target groundfish species. Additional information regarding the flatfish complexes in the BSAI and GOA can be found in Section 3.2.4 of this report and in the Groundfish Draft Programmatic SEIS (NMFS 2001a).

None of the alternatives evaluated in the cumulative effects analysis includes specific management measures adjusting the fishery for SSL protection. Rather, these fisheries are affected by changes in management measures for pollock, cod, and Atka mackerel. Flatfish species in general share a similar extent and magnitude of direct and indirect, and external effects, as noted in Section 4.2.5.1.

External Factors and Consequences

BSAI yellowfin, rock and flathead sole, Greenland turbot, arrowtooth flounder and Alaska plaice, and GOA arrowtooth flounder: Foreign fisheries, halibut longline fisheries, and the JV fishery are identified as having negative effects on this group of flatfish stocks through fishing mortality. The foreign and JV fishery is also believed to have had an affect via spatial and temporal concentration of catch, but the magnitude of this effect is unknown. However, there was no lingering past influence identified for either effects category. Similarly, the foreign and JV fishery are also believed to have affected habitat suitability and prey availability for these stocks, but the direction of these effects could be either positive or negative depending on the species and the specific fishery impact. Natural events including short term and long term climate variability, and ecological regime shifts are also identified as having had potentially positive or negative effects on habitat suitability and prey availability. In general, conditions have been favorable for flatfish in the BSAI and GOA during warmer water conditions prevalent since the late 1970s. The combination of human controlled and natural external effects on habitat suitability and prey availability are found to have had lingering effects on these flatfish stocks.

BSAI "Other Flatfish," and GOA shallow water flatfish, deep water flatfish, and flathead sole: Direct foreign fisheries, the JV fishery, and the halibut longline fishery are all found to have had negative past impacts on this group of stocks through fishing mortality. Effects on these stocks via spatial and temporal distribution of catch in these fisheries is also identified, but the magnitude of this effect is unknown. A lingering past influence from the negative effects of these fisheries is identified for fishing mortality. A lingering effect may also exist due to the spatial and temporal distribution of catch, but this is unknown. These fisheries were also found to have had effects on habitat suitability and prey availability. These effects could be either positive or negative, depending on the species and the effect being considered. An exception

is the effect of the halibut longline fishery on prey availability, which was found to be negative. This negative effect is believed to be minor (see Section 4.2.5). Natural events including short term and long term climate variability, and ecological regime shifts are also identified as having had potentially positive or negative effects on habitat suitability and prey availability. As noted above, conditions have generally been favorable for flatfish in the BSAI and GOA during warmer water conditions prevalent since the late 1970s (see Section 4.13). The combination of these factors contributes to the identification of lingering past influences on habitat suitability and prey availability for this group of species.

Analysis and Significance of Cumulative Impacts

BSAI yellowfin, rock and flathead sole, Greenland turbot, arrowtooth flounder and Alaska plaice, and GOA arrowtooth flounder: The halibut longline fishery is the only human controlled external effect identified for this group. The effect of this fishery on fishing mortality is rated as negative. No other effects categories are impacted. Short term and long term climate variability and associated ecological regime shifts are also identified as having the potential to positively or negatively affect habitat suitability and prey availability. As noted in Section 4.13, the effects of climate and regime shifts can have positive, negative, or potentially neutral effects on the recruitment and survival of flatfish species and the availability of their prey.

BSAI "Other Flatfish," and GOA shallow water flatfish, deep water flatfish, and flathead sole: The halibut longline fishery is identified as having impacts on all effects categories for this group of species. Effects on fishing mortality are judged to be negative. Effects on these stocks due to spatial and temporal concentration of catch are identified but the magnitude of these effects is unknown. Effects on habitat suitability for these stocks is judged to be negative, while effects on prey availability may be either positive or negative.

The scallop fishery is also identified as having effects via spatial and temporal concentration of catch, but the magnitude of these effects is unknown. This fishery is also identified as affecting habitat suitability and prey availability for these species, with the effects being either positive or negative.

Short term and long term climate variability and associated ecological regime shifts are also identified as having the potential to positively or negatively affect habitat suitability and prey availability for these species. As noted in Section 4.13, the effects of climate and regime shifts can have positive, negative, or potentially neutral effects on the recruitment and survival of flatfish species and the availability of their prey.

Cumulative effects under Alternatives 1 through 5 are described below and ratings are presented in Tables 4.13-14 and 4.13-15:

- **Fishing Mortality:** No modifications of flatfish TAC are proposed under any of the alternatives (no direct effects), so any changes in fishing mortality would be due to indirect effects from the spatial/temporal partitioning of the Pacific cod fishery. While the indirect effects of the groundfish fishery are believed to be insignificant under all of the alternatives, a cumulative effect is identified for fishing mortality for all flatfish species in the BSAI and GOA due to the negative effects of the halibut longline fishery. In the case of "other flatfish" in the BSAI, and shallow and deep water flatfish, rex sole and flathead sole in the GOA a lingering past influence from negative impacts fishing mortality is identified. This lingering influence, in combination with predicted fishing effort in the halibut longline fishery and the extent of the flatfish fishery under Alternatives 1 through 5 result in identification of a cumulative effect in each case. This effect is judged to be insignificant under each alternative, because the mortality from the halibut fishery is expected to be minor, as are any lingering past effects of fishing mortality. The combination of these effects will not threaten to push any flatfish stocks past their OFL under any of the alternatives.

- **Spatial and Temporal Concentration of Catch:** No cumulative impact is identified for any alternative for BSAI yellowfin, rock and flathead sole, Greenland turbot, arrowtooth flounder and Alaska plaice, and GOA arrowtooth flounder due to spatial and temporal concentration of catch. Insignificant direct or indirect effects are projected under any of the alternatives for this effects category, and no external effects are identified (see Table 4.13-14). A cumulative effect is identified for "other flatfish" in the BSAI, and shallow water flatfish, deep water flatfish, and flathead sole in the GOA under all alternatives due to the unknown magnitude of indirect and human controlled external effects, and past influences on the fishery. The magnitude of this cumulative effect is rated as unknown (see Table 4.13-15).
- **Habitat Suitability and Prey Availability:** Cumulative effects are identified for habitat suitability and prey availability for all flatfish stocks under every alternative due to factors associated with short and long term climate variability, and regime shifts, and the lingering past influences of these effects in conjunction with human controlled factors. In the case of yellowfin, rock and flathead sole, Greenland turbot, arrowtooth flounder and Alaska plaice in the BSAI, and arrowtooth flounder in the GOA, this effect is rated as insignificant for all alternatives (see Table 4.13-14). Cumulative effects on habitat suitability and prey availability for "other flatfish" in the BSAI, and shallow water flatfish, deep water flatfish, and flathead sole in the GOA, are also influenced by the halibut longline and scallop fisheries. The halibut longline fishery is identified as having negative effects on habitat suitability. Other effects on habitat suitability and prey availability may either be positive or negative. Due to the uncertainty regarding indirect effects on this group of species, the magnitude of cumulative effects is rated as unknown for Alternatives 1 through 5 (see Table 4.13-15).

Table 4.13-14

Summary of Cumulative Effect Analysis for BSAI Yellowfin Sole, Rock Sole, Greenland Turbot, Flathead Sole, Arrowtooth Flounder, and Alaska Plaice, and GOA Arrowtooth Flounder

Past Effects

Direct/Indirect Effects of Groundfish Fishery	
Category	
Fishing Mortality	
Spatial Temporal Conc.	
Habitat Suitability	
Prey Availability	

Past External Effects			
Human Controlled		Natural Events	
Foreign Fisheries	Halibut Longline	JV	Climate and Regime Shifts
-	-	-	0
U	0	U	0
+/-	0	+/-	+/-
+/-	0	+/-	+/-

Lingering Past Influence? Y/N
N
N
Y
Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery	Rating
Fishing Mortality	NS
Spatial Temporal Conc.	NS
Habitat Suitability	NS
Prey Availability	NS

Present and Predicted Future External Effects	
Human Controlled	Natural Events
Halibut Longline	Climate and Regime Shifts
-	0
0	0
0	+/-
0	+/-

Lingering Past Influence Y/N
N
N
Y
Y

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	N
N	
Y	N
Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-15 Summary of Cumulative Effect Analysis for BSAI "Other Flatfish," and GOA Shallow Water Flatfish, Deep Water Flatfish, and Flathead Sole

Past Effects

Category	Past External Effects				Lingering Past Influence? Y/N
	Human Controlled			Natural Events	
	Direct Foreign Fisheries	JV	Halibut Longline	Climate and Regime Shifts	
Fishing Mortality	-	-	-	0	Y
Spatial Temporal Conc.	U	U	U	0	U
Habitat Suitability	+/-	+/-	+/-	+/-	Y
Prey Availability	+/-	+/-	-	+/-	Y*

Direct/Indirect Effects of Groundfish Fishery	Past External Effects				Lingering Past Influence? Y/N
Category	Human Controlled			Natural Events	
	Direct Foreign Fisheries	JV	Halibut Longline	Climate and Regime Shifts	
Fishing Mortality	-	-	-	0	Y
Spatial Temporal Conc.	U	U	U	0	U
Habitat Suitability	+/-	+/-	+/-	+/-	Y
Prey Availability	+/-	+/-	-	+/-	Y*

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Rating
Category		
Fishing Mortality	U	
Spatial Temporal Conc.	U	
Habitat Suitability	U	
Prey Availability	U	

External Effects			
Human Controlled		Natural Events	
Halibut Longline	Scallop Fishery	Climate and Regime Shifts	
-	0	0	
U	U	0	
-	+/-	+/-	
+/-	+/-	+/-	

Lingering Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Y	Y	N*
U	Y	U
Y	Y	U
Y	Y	U

*mortality from halibut fishery expected to be minor.

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Rockfish

The cumulative effects analysis for rockfish is organized based on the evaluation of direct and indirect effects in Section 4.2.5.2. The analysis is separated to evaluate effects on BSAI Pacific Ocean perch (POP) individually; BSAI red rockfish (sharpchin, northern, rougheye, and shortraker) and other rockfish (all other species) as a group; and GOA rockfish species as a group. The cumulative effects analysis for BSAI POP is summarized in Table 4.13-16. The analysis for BSAI red and other rockfish is summarized in Table 4.13-17, and the analysis for GOA rockfish is summarized in Table 4.13-18.

Affected Environment Factors

At least 32 species of rockfish have been reported to occur in the GOA and BSAI, several of which are of commercial importance. Pacific ocean Perch has historically been the most abundant rockfish species in the region. Rockfish are long lived, slow -growing demersal species which do not tend to form dense aggregations. For additional abundance and life history information refer to Section 3.2.5 of this document.

None of the alternatives directly affect any of the rockfish species through changes in fisheries management. However, indirect effects may result from changes in rockfish bycatch due to modifications of the affected fisheries (walleye pollock, Pacific cod, and Atka mackerel), as noted in Section 4.2.5.2.

External Factors and Consequences

BSAI POP: Past directed foreign fisheries and JV fisheries are identified as having had a negative effect on BSAI POP. These negative effects contribute to a past influence that lingers to the present for this stock. These fisheries are also identified as having an unknown level of effect on the stock through the spatial and temporal distribution of catch, but the magnitude of this effect is unknown. No lingering past influence from these effects can be discerned from the known effects due to fishing mortality. The foreign, JV, and halibut longline fisheries are all identified as having had a negative effect on the habitat suitability of BSAI POP. The foreign and JV fishery are also noted as having had an effect on prey availability, but the direction of this effect could be either positive or negative depending on the fishery and specific effect. Commercial whaling is also identified as having had a past positive effect on prey availability, due to the removal of large scale competitors for prey from the ecosystem. Short term and long term climate variability and associated ecological regime shifts are identified as having had both positive and negative effects on BSAI POP. The combination of these factors for habitat suitability and prey availability contribute to lingering past influences on both effects categories.

BSAI red rockfish and other rockfish: Past foreign fisheries and JV fisheries are identified as having had a negative effect on red and other rockfish in the BSAI. These negative effects contribute to a past influence that lingers to the present for these stocks. These fisheries are also identified as having an unknown level of effect on all rockfish stocks through the spatial and temporal distribution of catch, but the magnitude of this effect is unknown. No lingering past influence from these effects can be discerned from the known effects due to fishing mortality. The foreign, JV, and halibut longline fisheries are all identified as having had a negative effect on the habitat suitability of BSAI red and other rockfish. Commercial whaling is also identified as having had a past positive effect on prey availability, due to the removal of large scale competitors for prey from the ecosystem. Short term and long term climate variability and associated ecological regime shifts are identified as having had both positive and negative effects. The combination of all factors contribute to lingering past influences on both effects categories.

GOA rockfish: Past foreign, JV, and halibut longline fisheries are identified as having had a negative effect on all GOA rockfish stocks. These negative effects contribute to a past influence that lingers to the present for these stocks. The foreign and JV fisheries are also identified as having an effect of unknown magnitude

on all rockfish stocks through the spatial and temporal distribution of catch. The halibut longline fishery had a negative effect on these stocks. A past influence of these effects was identified. The foreign, JV, and halibut longline fisheries are all identified as having had a negative effect on the habitat suitability of GOA rockfish. Short term and long term climate variability and associated ecological regime shifts are identified as having had both positive and negative effects on habitat suitability and prey availability. The combination of all factors contribute to lingering past influences on both effects categories.

Analysis and Significance of Cumulative Effects

Differences in effects was not identified between Alternatives 1 through 5 for all BSAI and GOA rockfish. In general, the alternatives all result in indirect effects on these stocks that are insignificant, or are unknown due to lack of information about a given stock. None of the alternatives involve any changes in rockfish fisheries management, so there are no identifiable direct effects (see Section 4.2.5.2). The cumulative effect analysis for BSAI rockfish is separated into findings for POP and for red and other rockfish. The findings for POP are more certain, due to the greater level of information available on this stock. The cumulative effects analyses for these stocks are summarized in Tables 4.13-16 and 4.13-17, respectively. GOA rockfish are exposed to a different suite of external effects, but as with the BSAI stocks there are no direct effects and little difference in indirect effects identified between Alternatives 1 through 5. The results of the cumulative effects analysis for GOA rockfish are summarized in Table 4.13-18. The cumulative effects analyses for all BSAI and GOA rockfish stocks are discussed below.

BSAI POP, red rockfish and other rockfish: The halibut longline fishery is identified as having a negative effect on the habitat suitability of BSAI POP, red rockfish and other rockfish. Short term and long term climate variability and associated ecological regime shifts are identified as having both positive and negative potential effects on habitat suitability and prey availability for these stocks. No external effects on fishing mortality and spatial and temporal concentration of catch are identified (see Tables 4.13-16 and 4.13-17).

- ***Fishing Mortality:*** Indirect effects from fishing mortality on BSAI rockfish stocks are projected to be insignificant for all alternatives (no direct effects are identified for any alternative, see Section 4.2.5.2). The BSAI POP stock is depleted due to past overfishing, and is currently above but close to the OFL. Therefore, a cumulative effect is identified for every alternative from the combination of indirect effects on fishing mortality with the lingering past influence of the foreign and JV fisheries on these stocks. The cumulative effect is rated as insignificant because POP populations are recovering. Overall, Alternatives 1 through 5 are essentially equivalent in terms of cumulative effects on fishing mortality for all BSAI rockfish.
- ***Spatial and Temporal Concentration of Catch:*** Projected indirect effects on BSAI POP due to spatial and temporal concentration of catch from Alternatives 1 through 5 are rated as insignificant. The projected indirect effects on red rockfish and other rockfish in the BSAI are unknown. Given the low level of effect expected for this effects category and the lack of a lingering past influence, no cumulative effect is identified for any alternative.
- ***Habitat Suitability:*** Projected indirect effects from Alternatives 1 through 5 on habitat suitability for BSAI POP are rated as insignificant. The projected indirect effects on red rockfish and other rockfish in the BSAI are unknown. A negative external effect on habitat suitability is identified for the halibut longline fishery, and potentially positive or negative effects are identified from short term and long term climate variability and associated ecological regime shifts. These effects apply equally to all alternatives. Given this negative external effect, and the lingering past influence of foreign, JV, and halibut longline fisheries on habitat suitability, a cumulative effect on this effects category is identified for all alternatives. In each case, this effect is rated as insignificant.

- **Prey Availability:** Projected indirect effects on prey availability for BSAIPOP are rated as insignificant for Alternatives 1 through 5. The projected indirect effects on red rockfish and other rockfish in the BSAI are rated as unknown for Alternatives 1 through 5. Potentially positive or negative effects are identified from short term and long term climate variability and associated ecological regime shifts. These effects apply equally to all alternatives. Given the potential for these effects and the lingering past influence of foreign, JV, and halibut longline fisheries, a cumulative effect on habitat suitability is identified for all alternatives. In each case, this effect is rated as insignificant.

GOA rockfish: The halibut longline and sport fishing are identified as having negative effects on GOA rockfish due to fishing mortality and the spatial and temporal distribution of catch. Short term and long term climate variability and associated ecological regime shifts are identified as having the potential for both positive and negative effects on habitat suitability and prey availability for these species (see Table 4.13-18).

- **Fishing Mortality and Spatial and Temporal Concentration of Catch:** Projected indirect effects from fishing mortality and spatial and temporal concentration of catch are projected to be insignificant for GOA rockfish stocks under all alternatives (no direct effects are identified for any alternative, see Section 4.2.5.2). Negative effects on these effects categories are identified from the halibut longline fishery and sport fisheries. A cumulative effect is identified for GOA rockfish under every alternative due to the combination of indirect effects, negative external effects from halibut and sport fisheries, and the past influence of the foreign and JV fisheries. This effect is rated as insignificant for both categories under all alternatives. The alternatives are essentially equivalent in terms of their influence on these effects categories.
- **Habitat Suitability and Prey Availability:** Projected indirect effects from Alternatives 1 through 5 on habitat suitability and prey availability for GOA rockfish are unknown. However, the level of effect is expected to be minor. Potentially positive or negative external effects are identified from short term and long term climate variability and associated ecological regime shifts. These effects apply equally to all alternatives. Given the future potential for climate variability and ecological regime shifts, and the lingering past influence of these factors, cumulative effects are identified for both effects categories under all alternatives. In each case, this effect is rated as insignificant.

Table 4.13-16 Summary of Cumulative Effect Analysis for BSAI Pacific Ocean Perch

Past Effects

Direct/Indirect Effects of Groundfish Fishery	Category	Past External Effects					Lingering Past Influence? Y/N
		Human Controlled			Natural Events		
Fishing Mortality		Foreign Fisheries	JV	Halibut Longline	Whaling	Climate and Regime Shifts	Y
Spatial Temporal Conc.		U	U	0	0	0	N
Habitat Suitability		-	-	-	0	+/-	Y
Prey Availability		+/-	+/-	0	+	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery	Rating	Present and Predicted Future External Effects			Lingering Past Influence? Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
		Human Controlled	Natural Events	Climate and Regime Shifts			
Fishing Mortality	NS	0	0	0	Y	Y	N*
Spatial Temporal Conc.	NS	0	0	0	N	N	
Habitat Suitability	NS	-	+/-	+/-	Y	Y	N
Prey Availability	NS	0	+/-	+/-	Y	Y	N

Notes: *Very close to OFL, but still above. Pacific ocean perch is at the OFL due to past overfishing
NS = Not Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-17 Summary of Cumulative Effect Analysis for BSAI Other Red Rockfish and Other Rockfish

Past Effects

Category	Past External Effects						Lingering Past Influence? Y/N
	Human Controlled				Natural Events		
Direct/Indirect Effects of Groundfish Fishery	Foreign Fisheries	JV	Halibut Longline	Whaling	Climate and Regime Shifts		
Fishing Mortality	-	-	0	0	0		Y
Spatial Temporal Conc.	U	U	0	0	0		N
Habitat Suitability	-	-	-	0	+/-		Y
Prey Availability	0	0	0	+	+/-		Y

Alternatives 1 through 5

Category	Present and Predicted Future External Effects			Rating
	Human Controlled	Natural Events	Climate and Regime Shifts	
Fishing Mortality	0	0	0	NS
Spatial Temporal Conc.	0	0	0	U
Habitat Suitability	-	-	+/-	U
Prey Availability	0	0	+/-	U

Lingering Past Influence? Y/N	
Y	N
N	
Y	U
Y	U

Cumulative Effect Y/N	
Y	N
N	
Y	U
Y	U

NS = Not Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-18 Summary of Cumulative Effects Analysis for GOA Rockfish

Past Effects

Direct/Indirect Effects of Groundfish Fishery	Past External Effects					Lingering Past Influence? Y/N
	Human Controlled			Natural Events		
Category	Foreign Fisheries	JV	Halibut Longline	Climate and Regime Shifts		
Fishing Mortality	-	-	-	0		Y
Spatial Temporal Conc.	U	U	-	0		Y
Habitat Suitability	-	-	-	+/-		Y
Prey Availability	0	0	0	+/-		Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Present and Predicted Future External Effects			Lingering Past Influence? Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events			
		Halibut Longline	Sport Fishing	Climate and Regime Shifts			
Fishing Mortality	NS	-	-	0	Y	Y	N
Spatial Temporal Conc.	NS	-	-	0	Y	Y	N
Habitat Suitability	U	0	0	+/-	Y	Y	U
Prey Availability	U	0	0	+/-	Y	Y	U

NS = Not Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Thornyheads

Affected Environment Factors

As described in Section 3.2.6, thornyheads in Alaskan waters are comprised of two species the shortspine thornyhead and the longspine thornyhead. They are close relatives of the rockfish. Little is known about thornyhead life history. Like other rockfish, they are long-lived and slow-growing. Biologically, the greatest area of uncertainty for this species is in their longevity and natural mortality rate.

There are currently no directed fisheries for thornyheads in the BSAI or GOA. Thornyheads are primarily caught as bycatch in longline fisheries directed at sablefish, and in trawl fisheries targeting deepwater flatfish in the GOA. Thornyhead bycatch in the BSAI in groundfish fisheries is generally negligible, therefore there is no evaluation of cumulative effects. The thornyhead fishery in the GOA is not specifically affected by any management changes under the Draft SSL Protection Alternatives, and any direct effects would occur as a result of changes in bycatch from the pollock and Pacific cod fishery (see Section 4.5.2.5). Because none of the alternatives proposed for SSL protection directly affect the fisheries where thornyheads are caught, there is effectively no difference between the alternatives in terms of cumulative effects.

External Factors and Consequences

Fishing mortality from foreign fisheries is identified as having had a negative effect on the GOA thornyhead stock that lingers to this day. Natural events, including short and long term climate variability and associated ecological regime shifts are identified as having potentially positive or negative effects on habitat suitability and prey availability for the GOA thornyhead stock. However, the magnitude of these effects on the stock is unknown and it is not clear if a lingering past influence persists to this day.

Analysis and Significance of Cumulative Effects

The cumulative effect analysis for GOA thornyheads under Alternatives 1 through 5 is summarized in Table 4.13-19. These matrices include a summary of direct and indirect effects, past effects, present and predicted future external effects, and cumulative effects. Present and predicted future external and cumulative effects are described in more detail below. The analysis of direct and indirect effects under each alternative is described in detail in Section 4.2.5.4.

Present and predicted external effects for GOA thornyheads include the influence of short term and long term climate variability, and associated ecological regime shifts on habitat suitability and prey availability. These effects may be either positive or negative depending on the specific conditions which prevail in the future. No human controlled external events are identified.

Cumulative effects on GOA thornyheads under Alternatives 1 through 5 are described below and are summarized in Table 4.13-19. As discussed above, there are no specific management changes to the fisheries which impact thornyheads as bycatch under any of the alternatives, so there are no differences amongst the alternatives in terms of cumulative effects.

- ***Fishing Mortality:*** Cumulative effects are identified for fishing mortality on GOA thornyheads. The past negative influence of foreign fisheries bycatch on fishing mortality also contributes to the finding of cumulative effects for this stock. These cumulative effects are judged to be insignificant under all alternatives, as the projected fishing mortality is rated as insignificant in every case (see Section 4.2.5.4).
- ***Spatial and Temporal concentration of Catch:*** There are no lingering past influences or predicted adverse effects on the GOA thornyhead stock from the spatial and temporal concentration of catch. The

direct and indirect effects of Alternatives 1 through 5 on this effects category are rated as insignificant. Given the lack of lingering past and predicted future external effects, and the lack of significant impacts from the Daft SSL Protection Alternatives, no cumulative effects are identified.

- **Habitat Suitability and Prey Availability:** No significant indirect effects are identified for either of these effects categories under any alternative. However, cumulative effects are identified for habitat suitability and prey availability for GOA thornyheads for Alternatives 1 through 5, due to the potential for positive or negative effects from short and long term climate variability and associated ecological regime shifts. In all cases, these effects are judged to be insignificant.

Table 4.13-19 Summary of Cumulative Effect Analysis for GOA Thornyheads

Past Effects

Direct/Indirect Effects of Groundfish Fishery	Past External Effects		Lingering Past Influence? Y/N
	Human Controlled	Natural Events	
	Foreign Fisheries	Climate and Regime Shifts	
Fishing Mortality	-	0	Y
Spatial Temporal Conc.	0	0	N
Habitat Suitability	0	+/-	U
Prey Availability	0	+/-	U

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		Present and Predicted Future External Effects	Lingering Past Influence? Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating				
		Climate and Regime Shifts			
Fishing Mortality	NS	0	Y	Y	N
Spatial Temporal Conc.	NS	0	N	N	
Habitat Suitability	NS	+/-	U	Y	N
Prey Availability	NS	+/-	U	Y	N

NS = Not Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Sablefish

Affected Environment Factors

Sablefish are found in the GOA westward to the Aleutian islands. They are typically found in deepwater habitats such as gullies and deep fjords at depths greater than 200 m. Sablefish are long lived with a maximum recorded age in Alaska of 62 years. Additional life history and distribution information for these fish can be found in Section 3.2.7 of this document.

Sablefish are primarily taken in deepwater longline fisheries in the BSAI and GOA. As discussed in Section 4.2.5.5, the majority of sablefish in the GOA are captured outside of SSL critical habitat. Therefore the fishery is only minimally affected by management changes proposed under the SSL protection alternatives. The sablefish catch in the BSAI takes place largely within SSL critical habitat, and area closures proposed under the SSL alternatives have the potential to reduce fishery effects on sablefish. However, as there are no clear criteria for defining a positive effect on the effects categories, none of these catch reductions were identified as significant (see Section 4.2.5.5).

External Factors and Consequences

Directed foreign fisheries, the JV, halibut longline fisheries, and the directed State and Canadian sablefish fisheries are all identified as having had negative past effects on sablefish fishing mortality. These fisheries are also believed to have negatively affected habitat suitability for sablefish. These past influences linger to the present for sablefish in both the GOA and the BSAI. The spatial and temporal concentration of catch in the State fishery is also identified as having had a negative effect. This effect is not believed to be observable in the current population. The foreign, JV, and halibut longline fisheries are also identified as having negatively affected prey availability for sablefish, and these effects have resulted in a lingering past influence. Short and long term climate variability, and associated ecological regime shifts are identified as having potential positive or negative effects on habitat suitability and prey availability. These effects have resulted in a lingering past influence on both effects categories.

Analysis and Significance of Cumulative Effects

Present and predicted future external effects are identified for the sablefish fishery for all effects categories. Negative effects from fishing mortality include the ongoing halibut longline fishery, the State fishery, and the Canadian fishery on transboundary stocks in Canadian waters. The State fishery also has negative effects on prey availability, and the spatial and temporal concentration of sablefish bycatch. Both the halibut longline fishery and the State fishery are identified as having negative impacts on habitat suitability. The State fishery is also identified as having a negative effect on prey availability. Short and long term climate variability, and associated ecological regime shifts have the potential to positively or negatively affect habitat suitability and prey availability for sablefish in the future.

Cumulative effects on the sablefish fishery under Alternatives 1 through 5 are summarized in Table 4.13-20, and are described below.

- ***Fishing Mortality:*** Negative external effects on fishing mortality from halibut longline, State, and Canadian fisheries have been identified for GOA and BSAI sablefish. These external effects, in combination with the lingering past effects on fishing mortality identified above, and direct and indirect effects from the sablefish fishery result in the identification of a cumulative effect on fishing mortality. The internal and external effects of Alternatives 1 through 5 on fishing mortality are judged to be insignificant (see Section 4.2.5.5). Because the stock has been fished for several decades and are in no jeopardy of falling below MSST the cumulative effects are judged to be insignificant.

- ***Spatial and Temporal Concentration of Catch:*** No lingering past effects due to spatial and temporal concentration of sablefish catch are identified. The combination of changes in this effect category under Alternatives 1 through 5 with the negative effects of the State fishery result in the finding of a cumulative effect. This effect is judged to be insignificant, as any changes in spatial and temporal concentration of catch under the alternatives are not expected to jeopardize the stocks ability to remain above MSST.
- ***Habitat Suitability and Prey Availability:*** No significant direct and indirect effects are identified for these effects categories under any of the alternatives. However, lingering past influences from human controlled and natural events continue to affect habitat suitability and prey availability. These past influences in conjunction with projected negative effects from the halibut longline and Alaska state fishery, and the potential for positive or negative effects from climate variability and regime shifts, results in a finding of cumulative effects for both effects categories. However, the combination of lingering past influences and present and predicted future effects on habitat suitability and prey availability are insufficient to jeopardize the stocks ability to remain above the OFL given the magnitude of direct and indirect effects predicted for each alternative. Therefore, cumulative effects under each alternative are rated as insignificant.

Squid and Other Species

As discussed in Section 4.2.5.6, the Squid and Other Species category includes species groups that are not currently economically important, but are ecologically important and may be exploited in the future. The Other Species group currently includes various species of sharks, skates, sculpins, squid, and octopus. These species are not currently targeted in any directed fishery, but are taken as bycatch in the groundfish fishery, and are therefore potentially subject to direct and indirect effects from changes proposed under the SSL protection measures.

Currently there is very little information on stock structure or statistics for any species in the Other Species group. The species complex is managed using an aggregate TAC based on limited stock assessment data and an a proportion of the total groundfish TAC. While changes in total catch and spatial and temporal concentration of catch under the SSL protection alternatives could potentially result in greater or lesser levels of bycatch, the resulting indirect effects on all effects categories are classified as unknown under each alternative (see Section 4.2.5.6). In addition, while several categories of external effects are identified for the Other Species group, the magnitude of these effects are unknown. Because the magnitude of direct, indirect, and external effects are unknown, it is not currently possible to identify cumulative effects for the Other Species group.

4.13.3 Non-Specified Fish Species

The non-specified fish species category is a diverse group of organisms that includes grenadiers, eelpouts, poachers, lumpsuckers, jellyfish, sessile benthic organisms (corals, sponges, anemones) and motile benthic organisms (non-prohibited crab, shrimp, echinoderms). As described in Section 4.3, the information available for analysis of non-specified species is extremely limited.

Direct effects on these species could include the removal of non-specified species from the environment as incidental catch in the Pacific cod, pollock, and Atka mackerel fisheries. Indirect effects would include habitat disturbance by fishing gear and disruption of food web interactions by disproportionate removal of one or more trophic levels. There is insufficient information available to estimate the indirect effects of changes in the incidental catch of non-specified species under all alternatives considered. Estimates of biomass, seasonal distribution of biomass and natural mortality are unavailable for non-specified species. Therefore the effects of the alternatives, such as the results of the redistribution of fishing effort over greater area and time spans, cannot be quantitatively described.

While external effects on these species are likely to have occurred in the past, unfortunately, bycatch data from the foreign fisheries, BSAI and GOA FMP foreign fishery observer program, and JV fisheries is nonexistent for most of these organisms. The State of Alaska (State) groundfish fisheries and IPHC halibut fisheries do not keep bycatch records. It is likely that the past influences have occurred; however, the magnitude of the potential effect on these populations cannot be determined due to the lack of pertinent information. Therefore, the degree of significance of any past, present, and predicted external influences are unknown in the BSAI and GOA non-specified fish populations.

Effects due to bycatch of non-specified fish are probable, but unquantifiable, under each of the proposed alternatives (see Section 4.3) and are also probable due to the external fisheries; therefore a cumulative effect due to bycatch is possible. However, because the significance of effects due to each alternative is unknown, the significance of any potential cumulative effects is also unknown.

4.13.4 Forage Fish

As discussed in Section 3.4, forage fish species play a critical role in the process of energy transfer in the marine ecosystems of the BSAI and GOA, and are an important food source for marine mammals (including Steller sea lions), sea birds, and numerous fish species. Forage fish are taken as bycatch in the groundfish fisheries of the BSAI and GOA. The projected direct and indirect effects of Alternatives 1 through 5 on forage fish are evaluated in Section 4.4. However, information upon which these evaluations are based is extremely limited, and the results are purely qualitative. With regard to past effects, it can be inferred that past foreign, JV, and domestic groundfish fisheries had forage fish bycatch rates that are proportionally similar to the current domestic fisheries. It is probable that past external effects from bycatch occurred and that they had population level effects on the various groundfish species, but these effects cannot be evaluated due to a lack of information. With regard to predicted effects, the limited information on stock size and seasonal distribution for forage fish species limits the ability to predict how stocks will respond to external effects in the future.

Because of the inability to evaluate past and predicted future external effects, and the qualitative results of the direct and indirect effects analysis, a cumulative effect analysis of the impacts of the Draft SSL Protection Alternatives was not developed for forage fish species. Management concerns for forage fish species, data limitations, plans to address these concerns and research in progress are discussed in Section 4.5 of the Draft Programmatic SEIS (NMFS 2001a).

4.13.5 Prohibited Species

4.13.5.1 Summary of Affected Environment Factors

Prohibited species in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) include Pacific halibut, crab species, Pacific herring, and salmon species. Prohibited species cannot be retained when caught in the federal groundfish fisheries and must be returned to sea with minimal harm. prohibited species are non-groundfish species that typically were fully utilized in domestic fisheries prior the passage of the Magnuson-Stevens Act in 1976. Retention was prohibited in the foreign, joint venture, and domestic groundfish fisheries to eliminate any incentive that groundfish fishermen might otherwise have to target these species.. The Groundfish SEIS (NMFS 2001) details a variety of management measures that have been used to control the prohibited species bycatch.

Life history and affected environment factors pertinent to the cumulative effects discussion are provided in Section 4.13.5.3 for each individual prohibited species.

The following direct and indirect effects were included in Section 4.5 to characterize the potential effects of the groundfish fisheries on prohibited species:

- Bycatch of prohibited species as a function of the changes in catch of target groundfish species
- Spatial and temporal concentration of bycatch
- Prey competition (removal of prey species by the groundfish fisheries).

These direct and indirect effects are pertinent to the cumulative effects analysis and are described individually for each prohibited species in Section 4.13.5.3

4.13.5.2 Summary of External Factors and Consequences

A discussion of the general external effects screened for the cumulative effects analyses is presented in Section 4.13.1. The external effects determined to be applicable to the prohibited species cumulative effects analyses include the following:

- Past External Effects:
 - Foreign fisheries catch & bycatch
 - Joint venture (JV) and domestic fisheries bycatch
 - State fisheries catch and bycatch
 - International Pacific Halibut Commission (IPHC) halibut fishery catch (halibut only)
 - Resource development (salmon only)
 - Exxon Valdez Oil Spill (EVOS, herring in GOA only)
 - Short and long-term climatic and regime shifts
- Present and Predicted External Effects:
 - IPHC Halibut Fishery catch (halibut only)
 - State fisheries catch & bycatch
 - Short and long-term climatic and regime shifts. Short-term effects (1-2 seasons), long term effects (years), and regime shifts (decades) could have either a beneficial or adverse impact on mortality (considered as bycatch in the Cumulative effects tables). It is believed that only long-term and/or regime shifts could impact the prey availability for a given prohibited species since short-term (seasonal) changes in prey are unlikely to have population level effects on consumers.

4.13.5.3 Summary of Cumulative Effects

The following subsections provide information concerning the specific affected environment factors, and past, present, and predicted external factors and consequences, and analyze the cumulative effects for each of the prohibited species considered in this EIS: pacific halibut, red king crab, tanner crab, Pacific herring, and salmon.

Pacific Halibut

Affected Environment Factors

Pacific halibut are the largest flatfish in the North Pacific, and inhabit a wide range of bottom types. They are found from the Sea of Japan throughout the Bering Sea and GOA to southern California. Adult halibut are active swimmers that generally remain in the same region each year, traveling from summer inshore feeding grounds to deeper offshore winter spawning grounds. Halibut are predators throughout their lives, feeding on a wide range of prey species.

Pacific halibut are managed by the International Pacific Halibut Commission (IPHC). Halibut stocks are currently considered healthy. Halibut bycatch in the federal groundfish fisheries is controlled by the use of prohibited species catch (PSC) limits, or bycatch limits. PSC limits are released seasonally and may apply to specific target groundfish fisheries. Additional details concerning the life history, management and production history for pacific halibut is provided in Section 3.7.2 of the Alaska Groundfish Fisheries DPSEIS (NMFS 2001).

Table 4.13-21, which follows this section, summarizes the direct and indirect effects of Alternative 1-5 as predicted in Section 4.5 and of the pertinent external effects for halibut in the BSAI and GOA. The table was developed using the approach outlined in Section 4.13.1.

External Factors and Consequences

Pre-World War I fisheries targeting halibut in the North Pacific were relatively small. Market demand for halibut began to grow once technology was developed to ice and preserve the catch. Inspired fishermen began to explore for larger halibut resources, and a GOA halibut fishery began in 1911 off the south end of Baranof Island.

Pre-World War II foreign fisheries were also relatively small with an expansion of large scale fishing operations in the post-war period, ultimately leading to increases in the catches of groundfish in the BSAI and GOA. By 1985, the JV operations and growing United States domestic fleet had entered the scene, and continued the harvest of groundfish species. Federal groundfish fisheries have been prosecuted by an all domestic fleet since 1987 in the GOA and 1991 in the BSAI. Bycatch of halibut is associated with all historical groundfish fisheries to varying degrees. It is inferred that past foreign, JV, and domestic fisheries had higher or proportionally similar halibut bycatch to the current domestic groundfish fisheries. It is also inferred that halibut bycatch in the past fisheries was taken into account under the IPHC management process. Therefore, the influence of past fisheries on halibut populations is rated as 0 or no additional beneficial or adverse effect in the BSAI and GOA (Table 4.13-21).

None of the past fisheries discussed above is known to have had any additional beneficial or adverse effect on halibut populations due to spatial/temporal location of bycatch, or competition for prey species of halibut. Therefore, the past fisheries are rated as 0 or no additional effect for these indirect effects. Climate variability can have both beneficial and adverse effects on halibut populations. Therefore, this past, present, and predicted future external effect is rated as "+/-" (Table 4.13-21).

The IPHC management process tracks halibut biomass and accounts for halibut bycatch in the federal and state groundfish fisheries and direct catch in the Alaskan subsistence and sport halibut fisheries when issuing halibut allocations to the directed halibut fisheries. Therefore, the present and predicted future external effect of these fisheries is rated as 0 or no additional beneficial or adverse effect in the BSAI and GOA for all alternatives (Tables 4.13-21).

The IPHC external fisheries are not known to have had any additional beneficial or adverse effect on halibut populations due to spatial/temporal location of bycatch, or competition for prey species of halibut. Therefore, the IPHC fisheries are rated as 0 or no additional effect for these indirect effects in the BSAI and GOA for all alternatives (Table 4.13-21).

Analysis and Significance of Cumulative Effects

As summarized in Table 4.13-21, cumulative effects are not expected under all alternatives for the three categories of direct/indirect effects: bycatch, spatial/temporal concentration of bycatch, and prey competition.

Currently the halibut stocks are considered to be healthy. It is inferred that any lingering influences from halibut bycatch in past groundfish fisheries have been mitigated by the numerous BSAI and GOA FMP management measures to reduce bycatch in the federal groundfish fisheries. Predicted halibut bycatch in the federal groundfish fisheries under all alternatives is rated as insignificant (Section 4.5). Effects of past, present, and predicted external fisheries catch and bycatch are rated as 0 meaning "no effect" (Table 4.13-21).

"Bycatch" can also be considered as mortality from external effects not related to fishing. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. However, since the population is healthy and stocks are being maintained, the cumulative effect is determined to be insignificant.

The spatial/temporal concentration of halibut bycatch could have adverse effects by overharvesting a distinct genetic component of a stock. Halibut bycatch appears to be evenly spread throughout the federal groundfish fisheries (Section 4.5). In addition, Pacific halibut are considered to be a single stock from the Bering Sea down the Pacific west coast. The spatial/temporal concentration of halibut bycatch under all alternatives is rated as insignificant. Effects of past, present, and predicted external fisheries on spatial/temporal concentration of halibut are rated as 0 meaning "no effect". Because external effects are not present, a cumulative effect for BSAI and GOA spatial/temporal concentration of halibut bycatch is not identified.

Halibut feed on a wide variety of species from invertebrates to target groundfish. Because halibut have flexible feeding habits, they are likely to be able to respond to short-term localized shortages of one prey species by substituting another (NMFS 2001 Groundfish SEIS). The removal of halibut prey by groundfish fisheries is rated as insignificant under all alternatives. It is inferred that climatic effects on halibut prey availability are negligible or essentially 0 because halibut could shift to other prey species. Effects of past, present, and predicted external fisheries on halibut prey were rated as 0 or "no effect" (Table 4.13-21). Therefore cumulative effects for BSAI and GOA halibut prey competition is not identified.

Table 4.13-21 Cumulative Effects Summary - Halibut BSAI and GOA

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	IPHC Fishery	Foreign Fisheries Bycatch	JV & Domestic Fisheries Bycatch	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch (mortality)	0	0	0	+/-	+/-	+/-	N
Spatial/Temporal	0	0	0	0	0	0	N
Prey	0	0	0	0	0	0	N

*minimal effects expected

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events				
			IPHC Fishery	Short-term Climate Change	Long-term Climate Change		
Bycatch (mortality)	I	0	+/-	+/-	+/-	Y	N
Spatial/Temporal	I	0	0	0	0	N	
Prey	I	0	0	0	0	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Crab Species

The following subsections describe the affected environment, external contributing factors, and subsequent cumulative effects for red king crab, other king crab, tanner crab, and other tanner crab in the BS, AI, and GOA.

Affected Environment Factors

King and Tanner crabs share a similar life cycle. After mating, the female crabs carry the eggs for about 1 year, at which time the eggs hatch into free-swimming larvae. After several development changes, the larvae settle to the bottom and molt into non swimmers. They remain on the bottom in preferred habitat for several years until becoming sexually mature. Each life stage for crab stocks is concentrated at some combination of depth, habitat, geographic areas, and time of year. During each life stage, the crabs consume different prey and are consumed by different predators. Additional details concerning crab life history and distribution are provided in Section 3.7.1.1 of the Alaska Groundfish Fisheries Draft Programmatic SEIS (NMFS 2001).

Bering Sea and Aleutian Islands (BSAI) directed crab fisheries are currently managed by the Alaska Department of Fish & Game (ADF&G) through a federal king and tanner crab fishery management plan (FMP), effective in 1989. The National Marine Fisheries Service (NMFS) conducts annual trawl surveys for crab stock assessments in the BSAI, with the exception of golden king crab. Abundance estimates, generated by a model developed by ADF&G that incorporates trawl survey, commercial catch, and observer data, are used to set guideline harvest levels for the crab fisheries.

There is no FMP for Gulf of Alaska (GOA) crab stocks. The Alaska Board of Fisheries developed GOA crab management plans that are implemented by the ADF&G. Minimum stock size thresholds are determined for crab stocks with adequate biological and stock assessment information. Harvest rates are calculated based on stock abundance in relation thresholds. (ADF&G 2000b).

Bycatch of crab in other state fisheries is limited by bycatch caps. Only male crabs above a minimum legal size are allowed to be retained in the state crab fisheries. All sub-legal size crabs and mature females are required to be released unharmed as soon as possible. Crab seasons are set to avoid crab mating and molting periods (ADF&G 2000b).

Tables 4.13-22, 4.13-23, and 4.13-24, summarize the direct and indirect effects of Alternatives 1-5 as predicted in Section 4.5 and the external effects on crabs in the BSAI and GOA. The tables were developed using the approach outlined in Section 4.13.1.

External Factors and Consequences

Direct catch and bycatch of crabs are both associated with past foreign fisheries. During the mid-1960s, foreign fleets in the BSAI took record numbers of yellowfin sole and Pacific ocean perch. Crab bycatch is associated with both of these fisheries. It is inferred that crab bycatch increased proportionally with the yellowfin sole and Pacific ocean perch catches. In the Mid-1960s, the United States initiated several bilateral agreements with Japan and Russia to reduce gear conflicts between State of Alaska fixed-gear crab fisheries and foreign fisheries and allocate crab resources between the foreign fisheries and state fixed-gear crab fisheries. Past foreign fisheries generally targeted red king crab; however, crab bycatch could have been comprised of various species. It is inferred that the past foreign fisheries bilateral agreements were marginal management measures at best and probably did not provide any benefit to crab stocks. Therefore, the past external influence of these fisheries crab catch and bycatch is rates as “-” or adverse in the BSAI and GOA (Tables 4.13-22 through 4.13-24).

Crab bycatch and unobserved mortality due to interactions with bottom trawl gear is associated with past JV, federal and state groundfish fisheries, and state scallop fisheries. Crab bycatch is also associated with the directed state crab pot fisheries. Crab bycatch in past foreign fisheries was replaced with increased crab bycatch in the JV fisheries until 1987 when new bycatch limits were put into effect. As the JV fisheries were being phased out and the domestic fisheries phased in, crab bycatch increased once again, but was quickly addressed by the establishment of new crab bycatch limits. Bycatch of snow crab was unconstrained through 1996. It is inferred that crab bycatch, and the spatial/temporal concentration of the bycatch, were associated with the past JV, domestic, and state fisheries. Therefore, these indirect effects are rated as “-” in the BSAI and GOA (Tables 4.13-22 through 4.13-24).

Crabs are benthic feeders, generally feeding on invertebrates. It is inferred that past fisheries did not have any additional beneficial or adverse influence on crab stocks due to competition for prey species of crab. Therefore, the past fisheries are rated as 0 or no additional effect in the BSAI and GOA (Tables 4.13-22 through 4.13-24).

Climate variability can have an influence on crab populations and their prey, both beneficial and adverse. Therefore, this past, present, and predicted future external effect on BSAI and GOA crab mortality is rated as "+/-" for short and long term climate effects and for regime shifts. Impacts of climate on crab prey are rated as "+/-" for long-term and regime shifts since these changes could impact prey species sufficiently to cause crabs to shift to another prey item. Short-term climate changes would be unlikely to cause a major shift in prey availability (Tables 4.13-22 through 4.13-24).

State crab fisheries continue to occur and are highly managed by the state in cooperation with NMFS. Quota setting processes are responsive to fluctuations in crab stocks. Crab bycatch in the state and federal groundfish fisheries is taken into account under the state management processes. Therefore, the present and predicated future effects of the state crab fisheries are rated as 0 or no additional beneficial or adverse effect in the BSAI and GOA for the all alternatives (Tables 4.13-22 through 4.13-24).

The state crab fisheries are not known to have any additional beneficial or adverse effect on crab populations due to spatial/temporal location of catch or bycatch, or competition for prey species of crabs. Therefore, the external effect is rated as 0 or no additional effect for these indirect effects in the BSAI and GOA for all alternatives (Tables 4.13-22 through 4.13-24).

Red King Crab - Analysis and Significance of Cumulative Effects

Bycatch levels of red crab are rated as insignificant under all alternatives (Table 4.13-22). Due to the effects of the past external fisheries combined with the predicted bycatch under each alternative, a cumulative effect for BSAI red king crab stocks is identified. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. Past adverse influences on BSAI and GOA red king crab stocks due to direct catch or bycatch and climate change have been mitigated over time through groundfish fisheries area closures, bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans and conservation areas, and other management processes. Therefore, the cumulative effect of bycatch on BSAI and GOA red king crab populations is rated as insignificant.

Red king crab are widely distributed throughout the BSAI, as are the groundfish fisheries. Therefore, under all alternatives, the effect of spatial/temporal concentration of red king crab bycatch in the BSAI and GOA is rated as insignificant (Section 4.5). A cumulative effect is identified due to the combined effects of the past external fisheries and the effects of bycatch under the alternatives (Table 4.13-22). Past adverse effects on BSAI and GOA red king crab stocks due to spatial/temporal concentration of direct catch and/or bycatch have been mitigated over time through the establishment of groundfish fishery no trawl zones, gear restrictions, and other management processes. Therefore, the cumulative effect of spatial/temporal concentration of bycatch on BSAI and GOA red king crab populations is rated as insignificant.

Crabs are benthic feeders, generally feeding on invertebrates. Removal of crab prey species as bycatch in the groundfish fisheries is rated as insignificant under all alternatives (Table 4.13-22). The effects of climate variation on past, present, and future BSAI and GOA red king crab prey populations are unknown. Effects of past, present, and predicted external fisheries on red king crab prey are rated as 0. Therefore, the significance of any cumulative effects for BSAI and GOA red king crab prey competition is also unknown.

Table 4.13-22 Red King Crab and Tanner Crab BSAI and GOA Other Tanner Crab BS and GOA Other King Crab AI and GOA

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Fisheries Bycatch	State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
	Bycatch (mortality)	-	-	-	+/-	+/-	
Spatial temporal conc.	-	-	-	0	0	0	Y
Competition for prey	0	0	0	0	+/-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
			State Fisheries Catch	Short-term Climate Change	Long-term Climate Change			
Bycatch (mortality)	I	0	+/-	+/-	+/-	Y	Y	N
Spatial temporal conc.	I	0	0	0	0	Y	Y	N
Competition for prey	I	0	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Tanner Crab - Analysis and Significance of Cumulative Effects

Predicted groundfish fisheries bycatch levels are rated as non significant for all alternatives (4.13-22). Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. The combined effects of the past external fisheries, climate change, and the direct and indirect effects of the alternatives constitute a cumulative effect for BSAI and GOA Tanner crab stocks. Past potential adverse influences on BSAI and GOA Tanner crab stocks due to direct catch or bycatch have been mitigated over time through bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans, and other management processes. Therefore, the cumulative effect of bycatch (mortality) on BSAI and GOA Tanner populations is rated as insignificant.

Tanner crab are distributed on the continental shelf, with BSAI populations concentrated around the Pribilof Islands and north of the Alaska Peninsula. Tanner crabs are considered to be one stock in the Bering Sea. Tanner crab populations are protected by conservation zones in the Pribilof Islands. The direct Tanner crab fishery is closed, thereby reducing any potential effects of bycatch on the population. Therefore, under all alternatives, spatial/temporal bycatch concentration of Tanner crab in the BSAI and GOA is rated as insignificant (Table 4.13-22). The combined effects of the past external fisheries and the predicted effects of the alternatives constitute a cumulative effect for BSAI and GOA Tanner crab stocks (Table 4.13-22). Past adverse effects on BSAI Tanner crab stocks due to spatial/temporal concentration of direct catch and/or bycatch have been mitigated over time through groundfish fisheries area closures, bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans, and other management processes. Therefore, the cumulative effect of spatial/temporal concentration of bycatch on BSAI and GOA Tanner crab populations is rated as insignificant.

Crabs are benthic feeders, generally feeding on invertebrates. Under all alternatives, catch of crab prey is expected to be very low, so removal of crab prey species as bycatch in the groundfish fisheries is rated as insignificant for all alternatives (Table 4.13-22). The effects of climate variation on past, present, and future Tanner crab prey populations are unknown. Effects of past, present, and predicted external fisheries on Tanner crab prey are rated as 0. Due to the unknown effects of climate, the significance of a cumulative effect for BSAI Tanner crab prey competition is also unknown.

Other King Crab - Analysis and Significance of Cumulative Effects

For GOA and AI other king crab stocks, bycatch is rated as insignificant under all alternatives (Table 4.13-22). However, for the BS stock, Alternative 2 is predicted to have a conditionally significant negative effect (Table 4.13-23) due to an expected bycatch increases of 101% in the pollock fishery and 65% in the Pacific cod fishery (see Section 4.5 and Table 4.5.1-1). The combined effects of the past and external fisheries and the predicted impacts of the alternatives constitute a cumulative effect for other king crab stocks (Tables 4.13-22 and 4.13-23). Past adverse influences on BSAI and GOA other king crab stocks due to direct catch or bycatch have been mitigated over time through groundfish fisheries area closures, bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans and conservation areas, and other management processes. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. Therefore, the cumulative effect of bycatch (mortality) on AI and GOA other king crab populations is rated as insignificant. Due to the predicted large increase in BS other king crab bycatch and the conditionally significant impact of alternative 2 on crab bycatch, the cumulative impact for this alternative is also rated as conditionally significant (Table 4.13-23).

Table 4.13-23 Other King Crab BS

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Fisheries Bycatch	State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch (mortality)	-	-	-	+/-	+/-	+/-	Y
Spatial temporal conc.	-	-	-	0	0	0	Y
Competition for prey	0	0	0	0	+/-	+/-	Y

Alternatives 1, 3, 4, and 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	I	0	+/-	+/-	0	Y	Y	N
Spatial temporal conc.	I	0	0	0	0	Y	Y	N
Competition for prey	I	0	0	+/-	+/-	Y	Y	U

Alternative 2

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	CS-	0	+/-	+/-	0	Y	Y	Y-
Spatial temporal conc.	NS	0	0	0	0	Y	Y	N
Competition for prey	NS	0	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Blue king crab have a discontinuous distribution in the BSAI, with discrete populations around the Pribilof Islands, Saint Matthew Island, and Saint Lawrence Island. Golden king crab populations are found around the Pribilof Islands, St. Matthew Island, and the Aleutian Islands. Blue and golden king crab populations are protected by conservation zones in the Pribilof Islands and the lack of groundfish effort near Saint Matthew Island. Therefore, spatial/temporal concentration of other king crab bycatch under all alternatives is rated as insignificant for other king crab stocks (Tables 4.13-22 and 4.13-23). Due to the combined effects of the past, present, and predicted external fisheries catch and bycatch and the groundfish fisheries bycatch a cumulative effect is identified. Past adverse effects on BSAI other king crab stocks due to spatial/temporal concentration of direct catch and/or bycatch have been mitigated over time through groundfish fisheries area closures, bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans and conservation areas, and other management processes. Therefore, the cumulative effect of spatial/temporal concentration of bycatch on BSAI other king crab populations is rated as insignificant.

Crabs are benthic feeders, generally feeding on invertebrates. Catch of crab prey in the groundfish fisheries is very low, so removal of crab prey species as bycatch in the groundfish fisheries is rated as insignificant (Tables 4.13-22 and 4.13-23). The effects of climate variation on past, present, and future other king crab prey populations are unknown. Effects of past, present, and predicted external fisheries on other king crab prey are rated as 0. Due to the unknown effects of climate, the significance of a potential cumulative effect is also unknown.

Other Tanner Crab - Analysis and Significance of Cumulative Effects

For BS and GOA stocks, the predicted bycatch levels are rated as insignificant for all alternatives (Table 4.13-22). However, for the AI stock, Alternatives 2, 3, and 4 are predicted to have conditionally significant positive effects (Table 4.13-24) due to expected bycatch decreases in the Atka mackerel fishery of 100% for alternatives 2 and 3 and 65% for alternative 4 (see Section 4.5 and Table 4.5.1-1). Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. Due to the combined effects of the past external effects and the predicted effects of the alternatives on bycatch, a cumulative effect for other Tanner crab stocks is identified (Tables 4.13-22 and 4.13-24). Past adverse influences on BSAI other Tanner crab stocks due to direct catch or bycatch have been mitigated over time through establishment of the Opilio Bycatch Limitation Zone, bycatch limits, direct fishing quota setting, establishment of crab rebuilding plans, and other management processes. Therefore, the cumulative effect of bycatch (mortality) on BSAI Tanner populations is rated as insignificant. Due to the predicted large decrease in AI other king crab bycatch and the conditionally significant positive impact of alternatives 2, 3, and 4, the cumulative impact for these alternatives is also rated as conditionally significant (Table 4.13-24).

Other Tanner crab populations in the BSAI are distributed along the continental shelf, and are considered to be one stock. Under the all alternatives, spatial/temporal concentration of other Tanner crab bycatch in the is rated as insignificant (Tables 4.13-22 and 4.13-24). Due to the combined effects of the past external fisheries catch and bycatch and the groundfish fisheries bycatch a cumulative effect for other Tanner crab is identified (Tables 4.13-22 and 4.13-24). Past adverse effects on other Tanner crab stocks due to spatial/temporal concentration of direct catch and/or bycatch have been mitigated over time through groundfish fisheries area closures, bycatch limits, direct fishing quota setting, direct fishing area closures, establishment of crab rebuilding plans, and other management processes. Therefore, the cumulative effect of spatial/temporal concentration of bycatch on other Tanner crab populations is rated as insignificant.

Crabs are benthic feeders, generally feeding on invertebrates. Existing catch of crab prey in the groundfish fisheries is very low, so removal of crab prey species as bycatch in the groundfish fisheries is rated as insignificant (Tables 4.13-22 and 4.13-24). The effects of climate variation on past, present, and future other

Tanner crab prey populations are unknown. Effects of past, present, and predicted external fisheries on other Tanner crab prey are rated as 0. Therefore, the potential cumulative effect on BSAI other Tanner crab prey competition is also unknown.

Table 4.13-24 Other Tanner Crab AI

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
Category	Human Controlled			Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Fisheries Bycatch	State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch (mortality)	-	-	-	+/-	+/-	+/-	Y
Spatial temporal conc.	-	-	-	0	0	0	Y
Competition for prey	0	0	0	0	+/-	+/-	Y

Alternatives 1 and 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	I	0	+/-	+/-	0	Y	Y	N
Spatial temporal conc.	I	0	0	0	0	Y	Y	N
Competition for prey	I	0	0	+/-	+/-	Y	Y	U

Alternatives 2, 3, and 4

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	CS+	0	+/-	+/-	0	Y	Y	Y+
Spatial temporal conc.	I	0	0	0	0	Y	Y	N
Competition for prey	I	0	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Pacific Herring

Affected Environment Factors

Pacific herring spawn in nearshore areas and deposit adhesive eggs on intertidal and subtidal vegetation. Gulf of Alaska (GOA) herring are considered to be a genetically distinct population from Bering Sea and Aleutian Island (BSAI) herring. All herring are planktivores and are important components of nearshore food chains. The major populations of Alaskan herring are at moderate population levels and are relatively stable. Additional details concerning

Pacific herring are managed by the Alaska Department of Fish & Game (ADF&G) with annual quotas allocated by the Alaska Board of Fisheries. Although most herring are harvested in the sac-ro-e season in spring, fall seasons are also designated for food and bait harvesting. All directed herring fisheries occur in state waters and fluctuate depending on market demands. Alaska herring fishing quotas are based on a variable exploitation rate of 20 percent, with lower exploitation rates being used when stocks decline to near-threshold levels. Herring fisheries are managed by regulatory stocks (i.e., geographically distinct spawning aggregations). If more than one herring fishery occurs on a particular regulatory stock, percentages are allocated to each fishery. Additional information concerning herring life history and fisheries can be found in Section 3.7.4 of the Alaska Groundfish Fisheries DPSEIS (NMFS 2001).

Tables 4.13-25, 4.13-26 and 4.13-27 summarize the direct and indirect effects of Alternative 1-5 as predicted in Section 4.5 and the potential influences of the pertinent external effects on herring in the BS, AI and GOA. The tables were developed using the approach outlined in Section 4.13.1.

External Factors and Consequences

There are records of foreign herring harvests in the North Pacific as far back as 1878. Foreign herring harvests increased beginning in the 1900s, with annual harvests during the 1920s and 1930s as high as 113,400 metric tons. Foreign harvesting of herring was discontinued around 1980 (Section 4.6.1.3 of NMFS 2001a; ADF&G 2000b). It is inferred that unregulated catch of herring in past foreign directed herring fisheries could have had an adverse effect on herring populations. Therefore, this past external influence is rated as "-" or adverse in the BS, AI and GOA (Tables 4.13-25 through 4.13-27).

Herring bycatch is taken primarily in the trawl pollock fisheries. It is estimated that herring bycatch may have been as high as 7,300 to 9,100 metric tons in the late 1980s (NMFS 2001a). Herring caught as bycatch in trawl fisheries do not survive. Overall herring bycatch is higher in the BSAI than the GOA (Tables 4.6-19 and 4.6-20 of NMFS 2001a). By 1989, unrestrained bycatch in the trawl fisheries had jumped to high levels relative to exploitable biomass. Past federal groundfish fisheries bycatch combined with the state fisheries direct take have exceeded the state's herring harvest policy in the past. (Appendix A, BSAI FMP Amendment 16a Summary). Therefore, the past herring bycatch and direct catch in JV and federal groundfish fisheries, state herring fisheries, and subsistence are rated as "-" or adverse. EVOS is known to have caused some mortality in GOA herring stocks and is also listed as "-" (Tables 4.13-25 through 4.13-27).

None of the past fisheries discussed above is known to have had any additional beneficial or adverse effect on herring populations due to spatial/temporal location of bycatch, or competition for prey species of herring. Therefore, the past fisheries are rated as 0 or no additional effect for these indirect effects (Tables 4.13-25 through 4.13-27).

Herring fisheries continue to occur; however, they are highly managed by the state. Annual stock assessments from trawl surveys and quota setting processes are responsive to fluctuations in herring biomass. Therefore, the present and predicted future external effect of these fisheries is rated as 0 or no additional beneficial or adverse effect in the BSAI and GOA for all alternatives (Tables 4.13-25 through 4.13-27).

The external state herring fisheries are not known to have had any additional beneficial or adverse effect on herring populations due to spatial/temporal location of bycatch, or competition for prey species of herring. Therefore, the external fisheries are rated as 0 or no additional effect for these indirect effects in the BSAI and GOA for all alternatives (Tables 4.13-25 through 4.13-27).

Analysis and Significance of Cumulative Effects

As shown on Tables 4.13-25 through 4.13-27, cumulative effects were not identified for the categories of bycatch and spatial/temporal concentration of bycatch. A cumulative effect was determined for prey competition, but the significance of the impact is unknown.

For GOA stocks, the predicted bycatch levels are rated as insignificant for all alternatives (Table 4.13-27). However, for the AI stock, Alternatives 2 and 3 are predicted to have conditionally significant positive effects (Table 4.13-26) due to expected bycatch decreases in the Atka mackerel fishery of 100% under these alternatives (see Section 4.5 and Table 4.5.1-1). For the BS stock, Alternative 2 is predicted to have a conditionally significant negative effect on bycatch (Table 4.13-25). This is because bycatch is expected to increase by 54% in the Pacific cod fishery (see Section 4.5 and Table 4.5.1-1).

Past potential adverse influences on herring populations due to direct catch or bycatch (mortality) have been mitigated through management processes and are not thought to have a lingering effect on current herring populations. Present and predicted external herring fisheries are not considered as having any additional beneficial or adverse effect on herring populations. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. However, since the population is healthy and stocks are being maintained, the cumulative effect is determined to be insignificant. Therefore, because there are no past, present, or predicted external effects, a cumulative effect of bycatch on BS, AI or GOA herring populations is not identified for any alternatives.

The spatial/temporal concentration of bycatch could have adverse effects by overharvesting a distinct genetic herring stock. GOA herring are considered to be genetically distinct from eastern Bering Sea herring. BSAI herring bycatch appears to be evenly spread throughout the federal pollock fishery (Figure 4.6-18 of NMFS 2001a). Herring bycatch in the GOA groundfish fisheries is very small compared to the BSAI (Tables 4.6-19

and 4.6-20 of NMFS 2001a). The spatial/temporal concentration of herring bycatch under all alternatives for all stocks is rated as insignificant (Tables 4.13-25 through 4.13-27). Effects of past, present, and predicted external fisheries spatial/temporal herring catch are rated as 0. Therefore, a cumulative effect for spatial/temporal herring bycatch was not identified under any of the alternatives.

Pacific herring prey on zooplankton, including pollock sand lance, and smelt larvae. Zooplankton are not a component of groundfish fisheries bycatch and are not targeted by the fisheries. Therefore, prey competition in the form of removal by the groundfish fisheries is rated as insignificant (Tables 4.13-25 through 4.13.5-7). Effects of past, present, and predicted external fisheries herring catch on herring prey are rated as 0. The effects of climatic variation on past, present, and future herring prey populations are unknown. Therefore, the significance of any potential cumulative effects on herring prey competition is also unknown.

Climate variability can have an influence on herring populations and their prey, both beneficial and adverse. Therefore, this past, present, and predicted future external effect on BSAI and GOA herring prey is rated as "+/-" (Tables 4.13-25 through 4.13-27).

Table 4.13-25 Herring BS Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Groundfish Fisheries Bycatch	State Herring Fisheries	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
	Bycatch	-	-	-	+/-	+/-	
Spatial/Temporal	0	0	0	0	0	0	N
Prey	0	0	0	0	+/-	+/-	Y

Alternatives 1 and 3 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
		State Herring Fisheries	Subsistence Fishery Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	I	0*	0*	+/-	+/-	0	N	Y	N
Spatial/Temporal	I	0	0	0	0	0	N	N	
Prey	I	0	0	0	+/-	+/-	Y	Y	U

Alternative 2

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
		State Herring Fisheries	Subsistence Fishery Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	CS-	0*	0*	+/-	+/-	0	N	Y	N
Spatial/Temporal	I	0	0	0	0	0	N	N	
Prey	I	0	0	0	+/-	+/-	Y	Y	U

*Herring fisheries continue to occur; however, they are highly managed by the state.

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-26 Herring AI - Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N
Category	Human Controlled			Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Groundfish Fisheries Bycatch	State Herring Fisheries	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch	-	-	-	+/-	+/-	0	N
Spatial/Temporal	0	0	0	0	0	0	N
Prey	0	0	0	0	+/-	+/-	Y

Alternatives 1, 4, and 5

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
		State Herring Fisheries	Subsistence Fishery Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	I	0*	0*	+/-	+/-	0	N	Y	N
Spatial/Temporal	I	0	0	0	0	0	N	N	
Prey	I	0	0	0	+/-	+/-	Y	Y	U

Alternatives 2 and 3

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
		State Herring Fisheries	Subsistence Fishery Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	CS+	0*	0*	+/-	+/-	0	N	Y	N
Spatial/Temporal	I	0	0	0	0	0	N	N	
Prey	I	0	0	0	+/-	+/-	Y	Y	U

*Herring fisheries continue to occur; however, they are highly managed by the state.

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-27 Herring GOA - Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects							Past Influence Y/N
Category	Human Controlled				Natural Events			
	Foreign Fisheries Catch & Bycatch	JV & Domestic Groundfish Fisheries Bycatch	EVOS	State Herring Fisheries	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch	-	-	-	-	+/-	+/-	0	N
Spatial/Temporal	0	0	0	0	0	0	0	N
Prey	0	0	0	0	0	+/-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects					Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events					
		State Herring Fisheries	Subsistence Fishery Catch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch	I	0*	0*	+/-	+/-	0	N	Y	N
Spatial/Temporal	I	0	0	0	0	0	N	N	
Prey	I	0	0	0	+/-	+/-	Y	Y	U

*Herring fisheries continue to occur; however, they are highly managed by the state.

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Salmon

Five species of pacific salmon including pink, chum, sockeye, coho, chinook, occur in Alaskan waters. The following sections discuss the affected environment, consequences and cumulative effects anticipated for these species.

Affected Environment Factors

Most Alaska salmon fisheries are healthy with bycatch representing a very small proportion of the directed catch. Pollock fisheries account for approximately 90 percent of the salmon bycatch in the Bering Sea and Aleutian Islands (BSAI) (Section 4.6.1.4 of NMFS 2001a). The western Alaska chinook and chum salmon stocks are currently considered depressed. Information on the stock composition of BSAI groundfish fisheries bycatch indicates that approximately 58–70 percent of chinook bycatch and 19 percent of chum bycatch may originate from western Alaskan stocks. Chum salmon from Asian stocks have also been identified in BSAI chum bycatch. The western chinook and chum proportion of Gulf of Alaska (GOA) bycatch is currently

unknown Additional descriptions of the life history, management, and production history of these species can be found in Section 3.7.3 of the Alaska Groundfish Fisheries DPSEIS (NMFS 2001a).

Pacific salmon have been managed by the Alaska Department of Fish & Game (ADF&G) since 1959. ADF&G also manages the salmon sport fisheries and permitted subsistence harvesting. Salmon fisheries are managed so that escapement goals are met for spawners in order to maintain sustained yields from the stock. Annual harvest sizes vary with fluctuating run sizes.

According to observer data, chum salmon account for the vast majority of other salmon bycatch in the BSAI (96 percent from 1997–1999). In the GOA, chum salmon also dominate the other salmon category (56 percent from 1997–1999). Tables 4.13-28 through 4.13-31 provide summarize the predicted impacts of alternatives 1-5, and the potential effects of the relevant external factors on salmon in the BS, AI and GOA. The tables were developed using the approach outlined in Section 4.13.1.

External Factors and Consequences

Direct catch and bycatch of salmon are both associated with past foreign fisheries. United States bilateral agreements with Japan and Russia attempted to reduce gear conflicts between State of Alaska salmon fisheries and foreign fisheries and allocate salmon resources to the state fisheries. It is inferred that the past foreign fisheries bilateral agreements were marginal management measures at best and probably did not provide any benefit to salmon stocks. Regulations implemented under the BSAI fisheries management plan (FMP) amendment process successfully reduced the foreign fisheries bycatch of salmon. The foreign fisheries salmon bycatch reductions were offset by increased salmon bycatch in the growing JV operations and domestic groundfish fisheries. Establishment of new salmon bycatch limits were issued to address the JV and domestic increased bycatch levels.

Salmon have a transboundary nature, hence western Bering Sea stocks have the potential to be caught in high-seas and Russian Exclusive Economic Zone (EEZ) fisheries. The North Pacific Anadromous Fish Commission coupled with the United Nations General Assembly Resolution 46/214, both established in 1993, prohibit high seas salmon fishing and ban large-scale pelagic driftnet fishing, respectively. In 1992, the United States and Russia signed a bilateral agreement calling for a ban on direct salmon fishing within both country's EEZs, but allowed for directed salmon fishing within 25 nautical miles of the baseline from which the EEZ is measured (NMFS 2001a; Pautzke 1997). With the exception of the occasionally-caught illegal fishing vessel, these measures are thought to provide effective management for salmon catch and bycatch outside the United States EEZ.

Salmon catch and/or bycatch is associated with past foreign, JV, and domestic groundfish fisheries. Therefore, these past fisheries are rated as “-” or having an adverse influence on BS, AI and GOA salmon stocks (Tables 4.13-28 through 4.13.5-31). Federal management of Alaska salmon in the pre-statehood era was weak and heavily influenced by the processing sector. The state took over salmon management after statehood in 1959. By the 1970s, state managers realized that salmon stocks were being over prosecuted by an ever growing fleet and initiated a limited entry system. Hatchery enhancement programs were also initiated to augment commercial salmon harvests (ADF&G 2000c). It is inferred that past state management practices were not as efficient as they are currently; therefore, past State salmon catch is rated as “-” or having had an adverse influence on BSAI and GOA salmon stocks (Tables 4.13-28 through 4.13-31).

The spatial/temporal concentration of bycatch could have adverse effects by overharvesting a distinct genetic component of a stock. Current spatial/temporal concentration of salmon bycatch in the BSAI seems to be relative to the distribution of the pollock fishery (Figures 4.6.1.4-1 and 4.6.1.4-5 of NMFS 2001a). Potential impacts to salmon from the current BSAI and GOA bycatch distribution have not been determined due to the uncertainty of bycatch stock composition. It is inferred that influences from past fisheries spatial/temporal

concentration of salmon catch and bycatch could have occurred; however, the magnitude of any such influences unknown. Therefore, the spatial/temporal concentration of BSAI and GOA salmon bycatch is rated as unknown for past, present and predicted under all alternatives (Tables 4.13-28 through 4.13-31).

Salmon species prey ranges from small fish, jelly fish, other soft bodied pelagic organisms, to zooplankton. Groundfish fisheries bycatch of salmon prey species ranges from low (e.g., forage fish species) to none (e.g., zooplankton). It is inferred that salmon prey bycatch was similar in the past foreign, JV, and domestic fisheries. A relationship between groundfish fisheries prey bycatch and salmon prey availability has not been determined; therefore, the BS, AI and GOA groundfish fisheries and state fisheries competition with salmon prey is rated as unknown for the past, present, and predicted under all alternatives (Tables 4.13-28 through 4.13-31).

Climate variability can have an influence on salmon populations and their prey, both beneficial and adverse. Therefore, the past, present, and predicted future external effects of climate on salmon mortality and prey is rated as "+/-" (Tables 4.13-28 through 4.13-31).

Direct catch and bycatch in the state fisheries is the only identified present and predicated future external effect on spatial/temporal concentration of salmon bycatch and salmon prey competition in the BSAI and GOA. However, the magnitude of the actual effect is unknown and appears as a "U" in the tables. The state fisheries are highly managed and salmon stock managers can respond very quickly to open and close fisheries depending on salmon run conditions. Therefore, the state fisheries effects on salmon stocks due to catch and bycatch are rated as 0 or no additional beneficial or adverse effect in the BS, AI and GOA for and all alternatives (Tables 4.13-28 through 4.13-31).

Analysis and Significance of Cumulative Effects

The cumulative effects analyses were based on two groupings of Alaska salmon in the BS, AI and GOA: Chinook salmon and other salmon. These groupings follow the official records maintained by the National Marine Fisheries Service (NMFS).

As shown on Table 4.13-28, for GOA salmon including Chinook, cumulative effects were identified across all alternatives for all three effect categories: bycatch, spatial/temporal concentration of bycatch, and competition for prey.

Because the salmon fisheries are highly managed, and the direct effects of the alternatives are expected to be insignificant for GOA salmon, the cumulative impact of bycatch (mortality) was determined to be insignificant. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. However, since the population is healthy and stocks are being maintained, the cumulative effect is determined to be insignificant. Because the impact of the state fisheries on spatial/temporal distribution and competition for prey is unknown, the significance of the cumulative effect is also unknown.

For BS salmon stocks including Chinook, the predicted bycatch levels are rated as insignificant for alternatives 1 and 3 through 5 (Table 4.13-29). However, alternative 2 is predicted to have conditionally significant positive effects on Chinook due to expected bycatch decreases in the pollock fishery of 59% under this alternative (see Section 4.5 and Table 4.5.1-1). For other salmon decreases in the Pacific cod fishery correspond to a reduction in bycatch of 65% (see Section 4.5 and Table 4.5.1-1).

Due to the combined effects of the past external effects and the predicted effects of the alternatives on bycatch, a cumulative effect for other BS salmon is identified (Table 4.13-29). Present and predicted external state fisheries are rated as 0 or not having any additional beneficial or adverse effect on salmon stocks because

the quotas are based on escapement. Changes in climate, both short term affecting a single year-class recruitment, and long-term and regime shifts which could affect additional year classes, have been identified. However, since the population is healthy and stocks are being maintained, the cumulative effect is determined to be insignificant. Therefore, the cumulative effect of bycatch on BS populations is rated as insignificant. Because the impact of the state fisheries on spatial/temporal distribution and competition for prey is unknown, the significance of the cumulative effect is also unknown.

Table 4.13-28 Salmon (including Chinook) GOA

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
Category	Human Controlled			Natural Events			
	Foreign Fisheries Direct & Bycatch	State Fisheries Direct & Bycatch	Resource Development	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch	-	-	0	+/-	+/-	0	Y
Spatial/Temporal	U	U	0	0	0	0	Y
Competition for prey	U	U	0	0	+/-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
			State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change			
Bycatch (mortality)	I	0	+/-	+/-	0	Y	Y	N
Spatial/Temporal	I	U	0	0	0	Y	Y	U
Prey	I	U	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-29 Salmon (including Chinook) BS Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	Foreign Fisheries Direct & Bycatch	State Fisheries Direct & Bycatch	Resource Development	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch (mortality)	-	-	0	+/-	+/-	0	Y
Spatial/Temporal	U	U	0	0	0	0	Y
Competition for prey	U	U	0	0	+/-	+/-	Y

Alternatives 1 and 3 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
			State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change			
Bycatch (mortality)	I	0	+/-	+/-	0	Y	Y	N
Spatial/Temporal	I	U	0	0	0	Y	Y	U
Prey	I	U	0	+/-	+/-	Y	Y	U

Alternative 2

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Bycatch (mortality)	CS+	0	+/-	+/-	0	Y	Y	Y+
Spatial/Temporal	I	U	0	0	0	Y	Y	U
Prey	I	U	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

For AI Chinook salmon stocks the predicted bycatch levels are rated as conditionally significant positive for alternatives 1, 2, 4, and 5, and conditionally significant adverse for alternative 3 (Table 4.13-30). These ratings are based on predicted decreases in Chinook bycatch of 78 %, 91%, 94% and 78% in the Atka mackerel fishery under alternatives 1, 2, 4, and 5, respectively (see Section 4.5 and Table 4.5.1-1). Under alternative 3 bycatch of chinook in this fishery is predicted to increase by 64%. For other salmon in the AI, impacts of all alternatives on bycatch are predicted to be insignificant (Table 4.13-31).

Due to the combined effects of the past external effects and the predicted effects of the alternatives on bycatch, a cumulative effect for AI salmon is identified (Tables 4.13-30 and 4.13-31). Present and predicted external state fisheries are rated as 0 or not having any additional beneficial or adverse effect on salmon stocks because the quotas are based on escapement. Therefore, the cumulative effect of bycatch on other salmon stocks is rated as insignificant for all alternatives (Table 4.13-31). For Chinook salmon, a conditionally positive cumulative impact is identified for alternatives 1, 2, 4, and 5 due to the large reduction in bycatch within the Atka mackerel fishery. Under alternative 3, an increase in bycatch in this fishery corresponds to a conditionally significant negative cumulative impact (Table 4.13-30).

For all alternatives the impact of the state fisheries on spatial/temporal distribution and competition for prey is unknown. Therefore, while a cumulative impact is identified for these categories, the significance of the cumulative effect unknown (Tables 4.13-30 and 4.13-31).

Table 4.13-30 Chinook Salmon AI Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects				Past Influence Y/N
	Human Controlled			Natural Events	
	Foreign Fisheries Direct & Bycatch	State Fisheries Direct & Bycatch	Resource Development	Climate & Regime Shifts	
	Category				
Bycatch	-	-	0	0	Y
Spatial/Temporal	U	U	0	0	Y
Competition for prey	U	U	0	+/-	Y

Alternatives 1, 2, 4, and 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
			State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change			
Bycatch (mortality)	CS+	0	+/-	+/-	0	Y	Y	Y+
Spatial/Temporal	I	U	0	0	0	Y	Y	U
Prey	I	U	0	+/-	+/-	Y	Y	U

Alternative 3

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
			State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change			
Bycatch (mortality)	CS-	0	+/-	+/-	0	Y	Y	Y-
Spatial/Temporal	I	U	0	0	0	Y	Y	U
Prey	I	U	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-31 Other Salmon AI - Cumulative Effects

Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence Y/N
	Human Controlled			Natural Events			
	Foreign Fisheries Direct & Bycatch	State Fisheries Direct & Bycatch	Resource Development	Short-term Climate Change	Long-term Climate Change	Regime Shifts	
Bycatch (mortality)	-	-	0	+/-	+/-	0	Y
Spatial/Temporal	U	U	0	0	0	0	Y
Competition for prey	U	U	0	0	+/-	+/-	Y

Alternatives 1 through 5

Direct/Indirect Effects of Groundfish Fishery		External Effects				Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled	Natural Events					
		State Fisheries Catch & Bycatch	Short-term Climate Change	Long-term Climate Change	Regime Shifts			
Short-term Climate Change	Long-term Climate Change	0	+/-	+/-	0	Y	Y	N
+/-	+/-	U	0	0	0	Y	Y	U
0	0	U	0	+/-	+/-	Y	Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.6 ESA Listed Pacific Salmon

Of the Northwest salmon species listed as endangered or threatened under the Endangered Species Act (ESA), only chinook and steelhead stocks are thought to migrate into areas managed by the BSAI and GOA groundfish FMPs. Steelhead salmon have not been observed in either BSAI or GOA groundfish fisheries salmon bycatch. Predicted bycatch of BSAI and GOA chinook does not exceed the upper take limits accepted under ESA section 7 consultation (55,000 in the BSAI and 40,000 in the GOA) under the status quo or any the alternatives. Therefore, no significant impacts to Endangered Species Act (ESA) listed steelhead and chinook salmon are anticipated from Alternatives 1 and 3 thorough 5. Alternative 2 could have a positive impact, seen as a reduction in bycatch of these species. Cumulative effects for salmon species in general are described in Section 4.13.5.6.

4.13.7 Seabirds

4.13.7.1 Summary of Affected Environment Factors

The seabirds or seabird groups considered in the analysis of cumulative effects include: northern fulmars, short-tailed albatross, other albatross and shearwaters, piscivorous (fish-eating) seabirds, and spectacled and Steller's eiders. Section 3.7 of this SEIS presents descriptions of these and other seabirds and their important life history characteristics, habitat requirements, food habits, and sensitivities to environmental stresses.

Direct and indirect impacts of the alternatives on seabirds are evaluated in Section 4.7 of this SEIS. For this cumulative effects analysis, one direct and three indirect effects are included:

Direct Effects: Incidental take (in gear and vessel strikes)

Indirect Effects: Prey (forage fish) abundance and availability
 Benthic habitat damage
 Processing waste and offal

4.13.7.2 Summary of External Factors and Consequences

A discussion of the general external effects screened in the cumulative effects analyses is presented in Section 4.13. The past, present, and predicted external effects determined to be applicable to the seabirds cumulative effects analyses include the following:

- Foreign fisheries
- State fisheries
- International Pacific Halibut Commission (IPHC) halibut fishery
- Short-term climatic shifts (1-2 seasons)
- Long-term climatic shifts (years)
- Regime shifts (decades)

The impact analysis of the different Alternatives begins with a history of past effects which, of course, will be the same for all of them. The following discussion on past effects is presented in much greater detail in the Groundfish Draft Programmatic SEIS (NMFS, 2001a). Past management decisions (FMP amendments) have focused on reducing the amount of seabird bycatch by instituting an observer program in the foreign and domestic fisheries. The program collects quantitative data for decision makers on actual species affected and catch rates (BSAI amendments 13, 27, 37 and GOA amendments 18 and 30). Directed fisheries on forage fish, important food sources for many species of fish-eating seabirds such as fulmars, albatross, shearwaters, murre, and kittiwakes were prohibited in order to prevent adverse effects on these seabirds (BSAI amendment 36 and GOA amendment 39).

Foreign fisheries have operated in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) from the 1940s to the 1980s. Throughout this period, seabird bycatch or entanglement in fishing gear was an undesired aspect of these fisheries. Attraction to processing waste from foreign processors in the past may also have had an effect on some seabird populations but little data is available as to whether the effect of the attraction and supplemental food is positive or negative (Furness and Ainley 1984, Gould et al. 1997).

Seabird bycatch became a major concern, especially in the high seas Japanese drift gillnet fisheries operating in the western North Pacific south of the Aleutian Islands and in the western Bering Sea (NRC 1996). Seabird bycatch levels in the 1970s ranged from 700,000 in the early 1970s to 400,000 birds annually in the mid 1970s (King et al. 1979). The bycatch was believed to be reduced in the late 1980s with the exclusion

of these fisheries from the U.S. Exclusive Economic Zone (EEZ) (DeGange and Day 1991). Ghost nets from this fishery also likely impacted many seabird species.

Based on recent research and recommendations from the Washington Sea Grant Program, NMFS is in the process of developing new regulations and mandatory procedures to reduce bycatch of all seabirds. It is expected that these procedures will reduce seabird bycatch by more than 90% of present levels.

Past International Pacific Halibut Commission (IPHC) halibut fisheries and state-managed longline and pot fisheries also had some level of negative effect on seabirds due to entanglement with gear and vessel collisions, but overall effects were likely much less than those due to the groundfish fisheries.

Long-term and short-term climate change and regimes shifts have very likely affected piscivorous and other seabird populations in the past. The extent of these effects is discussed in the Groundfish Draft Programmatic SEIS (NMFS, 2001a --Appendix J, Section 1.2) but actual effects on individual species are largely unknown.

4.13.7.3 Summary of Cumulative Effects

The following subsections summarize the past, present, and predicted affected environment factors, external factors, and the cumulative effects for each of the following seabird species/groups: northern fulmar, short-tailed albatross, other albatross and shearwaters, piscivorous seabirds, and spectacled and Steller's eiders. Only those specific effects which contribute to the cumulative impact on each species/group are discussed.

Northern Fulmars

Affected Environment Factors

Details concerning the life history, population biology, and foraging ecology of northern fulmars are provided in Section 3.5.1 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

Based on an analysis of seabird incidental catch in the groundfish fisheries and of seabird populations in Alaska (Table 3.3-6), the Groundfish Draft Programmatic SEIS (NMFS 2001a) concluded that the effects of incidental take were considered insignificant to seabird populations as a whole. It also concluded that northern fulmars were the only species showing a positive linear relationship between fishing effort and numbers of birds hooked. Approximately 10,000 fulmars are taken as bycatch each year but this is rated as insignificant at the population level.

The low volume of forage fish caught as bycatch in the groundfish fisheries would likely have little effect on the availability and abundance of prey for nesting seabirds, including fulmars. Based on the Groundfish Draft Programmatic SEIS (NMFS 2001a) analysis, the indirect fishery effects on fulmar's prey abundance and availability were considered negligible for all alternatives.

Northern fulmars are the primary species that consumes discards and processing waste, and have been attracted to fishing vessels or processors over many years. Evaluating the effect of this unnatural food source is difficult because reliable estimates of the intake of this food source relative to total food consumption are unknown for seabirds in Alaska.. For the analysis of present and predicted effects, it is assumed that the volume of offal and processing wastes changes approximately in proportion to the total catch in the fishery. Therefore, the volume of discarded offal and processing wastes would be expected not to change in the BSAI under Alternative 1, but might decrease slightly in the GOA. Direct or indirect effects of processing waste and offal on fulmar populations are not currently understood and are rated as insignificant under the Alternative 1.

Since they are not benthic feeders, fulmars are not expected to be impacted by any fishery-induced changes to benthic habitat.

Table 4.13-32, below, summarizes the direct and indirect effects of Alternatives 1-5 on northern fulmar as predicted in Section 4.7 of this SEIS. The table was developed using the approach outlined in Section 4.13.

External Factors and Consequences

Past adverse external effects on fulmars include incidental take in foreign and joint venture fisheries, state-managed fisheries and IPHC managed halibut fisheries. While fulmars were undoubtedly lost to these fisheries, precise numbers killed or overall effects on the population are not known. Incidental take from external fisheries continues to contribute to the present overall mortality of this species but, due to insufficient data from foreign fisheries, the significance of the impact is not known.

Past or present external adverse effects on prey availability and abundance are not identified from other fisheries. However, climate change would be expected to have substantial effects on seabird prey distribution, either positive or negative. The impact of this effect is not predictable with any degree of certainty. Forage availability during the breeding season is the primary factor affecting nesting success of many seabird species, including fulmars. Due to increasing population trends, northern fulmars do not appear to be prey-limited at this time.

As noted above, fulmars have been attracted to offal from fishing vessels for many years. The net impact of fishery waste from past and present external fisheries on populations of fulmars is unknown.

Table 4.13-32 summarizes the direct and indirect effects of the pertinent external effects on northern fulmar in the BSAI and GOA.

Analysis and Significance of Cumulative Effects

Incidental take of northern fulmars is found to be cumulative based on the effects of the groundfish fisheries and the external factors of other fisheries. The cumulative effect of incidental take/entanglement under Alternative 1 is considered to be insignificant based on the very large numbers of fulmars in the north Pacific (over one million pair in Alaska). Effects are considered insignificant in the GOA and unknown in the BSAI.

Lacking a clear direct or indirect effect of the groundfish fisheries on seabird prey species (forage fish), a cumulative effect for this factor was not identified for northern fulmar.

The indirect effects of processing waste and offal from the groundfish fishery may be either adverse or beneficial at the population level of fulmars. Since external effects are identified from foreign fisheries, state-managed fisheries, and IPHC halibut fisheries as contributing processing waste and offal which might be eaten by fulmars, the effect is determined to be cumulative. However, based on the lack of evidence of an adverse effect on fulmar populations and the large numbers of fulmars in the BSAI and GOA, the cumulative effect is expected to be insignificant.

Table 4.13-32 summarizes the cumulative impact assessment for northern fulmar.

Short-tailed Albatross

Affected Environment Factors

Details concerning the life history, population biology, and foraging ecology of short-tailed albatross are provided in Section 3.5.1 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

Incidental take of the endangered short-tailed albatross is a major concern of the groundfish fishery. While very few short-tailed albatross are taken incidentally in this fishery, due to the critically small population size of this endangered species, any longline mortality is of concern. Alternative 1 would have conditionally significant adverse effects on the short-tailed albatross with respect to incidental take. Due to the fact that fishing would continue at various levels under all alternatives, incidental take is considered to be a conditionally significant adverse effect for all alternatives.

Due to the wide-ranging foraging habits of short-tailed albatross, the Groundfish Draft Programmatic SEIS (NMFS 2001a) determined that the indirect fishery effects on prey abundance and availability for short-tailed albatross were negligible for all alternatives.

The indirect effect of processing waste and offal on the short-tailed albatross population is considered negligible for all alternatives. Since they are not benthic feeders, short-tailed albatross are not expected to be impacted by any fishery-induced changes to benthic habitat.

Table 4.13-33, below, summarizes the direct and indirect effects of Alternatives 1-5 on short-tailed albatross as predicted in Section 4.7 of this SEIS.

External Factors and Consequences

Since foreign fisheries are often not required to post observers onboard fishing vessels or report incidental take of seabirds, the numbers of short-tailed albatross taken in these fisheries are unknown. As discussed above, any mortality due to fishing activity is of great concern at the population level.

Past or present external fisheries effects on prey availability and abundance have not been identified. However, climate change would be expected to have substantial effects on seabird prey distribution, either positive or negative. The impact of this effect is not predictable with any degree of certainty. Due to their small but increasing population trend, short-tailed albatross do not appear to be prey-limited at this time.

The net impact of fishery waste from past and present external fisheries on the population of short-tailed albatross is unknown. Since it is not a benthic feeder, this species is not considered to have been impacted by any external changes to benthic habitat.

Table 4.13-33 summarizes the direct and indirect effects of the pertinent external effects on short-tailed albatross in the BSAI and GOA.

Analysis and Significance of Cumulative Effects

Because of the combined opportunity for incidental take of the endangered short-tailed albatross from both external and internal fishing activities, incidental take is considered to be a cumulative effect and to be a conditionally significant adverse effect for all alternatives.

Lacking a clear direct or indirect effect of the groundfish fisheries on prey species, a cumulative effect for this factor was not identified for short-tailed albatross.

Table 4.13-33 summarizes the cumulative impact assessment for short-tailed albatross.

Other Albatross and Shearwaters

This category includes black-footed and Laysan albatross as well as sooty and short-tailed shearwaters.

Affected Environment Factors

Details concerning the life history, population biology, and foraging ecology of these albatross and shearwater species are provided in Section 3.5.1 of the Groundfish Draft Programmatic SEIS (NMFS 2001a).

Based on an analysis of seabird incidental catch in the groundfish fisheries and of seabird populations in Alaska (Table 3.3-6), the Groundfish Draft Programmatic SEIS (NMFS 2001a) concluded that the effects of incidental take were considered insignificant to seabird populations as a whole. It also concluded that northern fulmars were the only species showing a positive linear relationship between fishing effort and numbers of birds hooked. This relationship did not exist for other bird groups, including albatross and shearwaters.

Due to the wide-ranging foraging habits of albatross and shearwaters, the Groundfish Draft Programmatic SEIS (NMFS 2001a) determined that the indirect fishery effects on prey abundance and availability for these species were negligible for all alternatives.

The indirect effect of processing waste and offal on albatross and shearwater populations is considered negligible for all alternatives. Since they are not benthic feeders, these species are not expected to be impacted by any fishery-induced changes to benthic habitat.

Table 4.13-34, below, summarizes the direct and indirect effects of Alternatives 1-5 on other albatross and shearwater species as predicted in Section 4.7 of this SEIS.

External Factors and Consequences

Present and predicted external effects are identified for incidental take of albatross and shearwaters by foreign fisheries, State-managed fisheries, and the IPHC halibut fisheries. Except for the possible negative impacts on black-footed albatross (see below), the species in this group do not appear to be affected at the population level by incidental take.

Past or present external fisheries effects on prey availability and abundance have not been identified. However, climate change would be expected to have substantial effects on seabird prey distribution, either positive or negative. The impact of this effect is not predictable with any degree of certainty.

The net impact of fishery waste from past and present external fisheries on the populations of albatross and shearwater species is unknown. Since they are not benthic feeders, these species are not considered to have been impacted by any external changes to benthic habitat.

Table 4.13-34 summarizes the direct and indirect effects of the pertinent external effects on other albatross and shearwater species in the BSAI and GOA.

Analysis and Significance of Cumulative Effects

The combined annual estimated take of black-footed albatross in the BSAI and GOA groundfish longline fisheries is 385 birds. External fisheries effects of incidental take in other parts of its range have indicated that this take could be contributing to a conditionally significant adverse effect on the black-footed albatross population (Section 4.7 of this analysis). It is expected that new regulations and procedures to reduce seabird bycatch in the groundfish fleet will greatly improve this situation. No cumulative impacts from incidental take were found for any other species in this category.

Lacking a clear direct or indirect effect of the groundfish fisheries on prey species, a cumulative effect for this factor was not identified for other albatross or shearwater species.

Table 4.13-34 summarizes the cumulative impact assessment for these albatross and shearwater species.

Piscivorous Seabirds

This group includes fish-eating seabirds that breed in Alaska: murre, kittiwakes, gulls, rhinoceros auklets, puffins, cormorants, jaegers, terns, guillemots, and murrelets

Affected Environment Factors

Details concerning the life history, population biology, and foraging ecology of piscivorous seabirds are provided in Section 3.5.1 of the Groundfish Draft Programmatic SEIS (NMFS 2001a). Based on an analysis of seabird incidental catch in the groundfish fisheries and of seabird populations in Alaska (Table 3.3-6), the Groundfish Draft Programmatic SEIS (NMFS 2001a) concluded that the effects of incidental take were considered insignificant to seabird populations as a whole. It also concluded that there was no linear relationship between fishing effort and numbers of piscivorous seabirds hooked.

The low volume of forage fish caught as bycatch in the groundfish fisheries would likely have little effect on the availability and abundance of prey for nesting piscivorous seabirds. Based on the Groundfish Draft Programmatic SEIS (NMFS 2001a) analysis, the indirect fishery effects on forage fish abundance and availability were considered unknown for all alternatives.

Alternative 1 is not expected to affect benthic-feeding species such as scoters, guillemots, or cormorants at a population level. Therefore, the effects of any of the five alternatives on benthic habitat are considered insignificant to these benthic-feeding seabird populations.

Some species in this group, notably the gulls, are attracted to fishery waste discarded from fishing and processing vessels. Evaluating the effect of this unnatural food source is difficult because reliable estimates of the intake of this food source relative to total food consumption is unknown for seabirds in Alaska. For the analysis of present and predicted effects, it is assumed that the volume of offal and processing wastes changes approximately in proportion to the total catch in the fishery. Therefore, the volume of discarded offal and processing wastes would be expected not to change in the BSAI under Alternative 1, but might decrease slightly in the GOA. Direct or indirect effects of processing waste and offal on gull populations are not currently understood and are rated as insignificant under all alternatives.

Table 4.13-35, below, summarizes the direct and indirect effects of Alternatives 1-5 on piscivorous seabirds as predicted in Section 4.7 of this SEIS.

External Factors and Consequences

While past effects from external fisheries may have been significant, most notably from the high seas drift fishery, these fisheries have been eliminated or greatly reduced and no longer take significant numbers of birds. None of the species in this group appear to be presently affected at the population level by incidental take.

Past or present external adverse effects on forage fish availability and abundance are not identified from other fisheries. However, climate change would be expected to have substantial effects on seabird prey distribution, either positive or negative. The impact of this effect is not predictable with any degree of certainty. Forage availability during the breeding season is the primary factor affecting nesting success of many seabird species, including those in this group.

Past external effects were identified for damage to benthic habitats from foreign fisheries but little is known of the extent of the actual damage.

External effects are identified from foreign fisheries, state-managed fisheries, and IPHC halibut fisheries as contributing processing waste and offal which might be eaten by some piscivorous species. The significance of the impact is not clearly understood but is considered to be insignificant at the population level.

Table 4.13-35 summarizes the direct and indirect effects of the pertinent external effects on piscivorous seabirds in the BSAI and GOA.

Analysis and Significance of Cumulative Effects

Based on potentially lingering effects from past external fisheries and the small but persistent take of piscivorous species in the groundfish fishery, a cumulative impact from incidental take was identified. However, this impact was considered insignificant for all species in this group at the population level.

Lacking a clear direct or indirect effect of the groundfish fisheries on seabird prey species (forage fish), a cumulative effect for this factor was identified but considered insignificant at the population level for all species in this group.

Lacking any indication of a benthic habitat effect from the groundfish fishery, effects on piscivorous species through benthic habitat changes were not found to be cumulative.

The impact of fishing wastes on piscivorous seabird species is considered to be cumulative over all the different types of fisheries but is considered to be insignificant at population levels.

Table 4.13-35 summarizes the cumulative impact assessment for these piscivorous species.

Spectacled and Steller's Eiders

Affected Environment Factors

Details concerning the life history, population biology, and foraging ecology of spectacled and Steller's eiders are provided in Section 3.5.1 of the Groundfish Draft Programmatic SEIS (NMFS 2001a). Since spectacled and Steller's eiders are threatened species under the ESA, their primary habitats have been afforded special protection. These areas are nearshore and have very little overlap with the groundfish fishery. Because of this

separation, the fishery is considered to have negligible effects on these eider species from incidental take, prey availability, and waste effects.

Present and predicted effects of bottom trawling on benthic habitat used by eiders in the BSAI and GOA are largely unknown but the extent of these effects is minimal since there is very little groundfish fishing within eider critical habitat areas. Potential damage to benthic habitat from any of the alternatives would not be expected to affect spectacled or Steller's eiders at a population level and are therefore considered insignificant.

Table 4.13-36, below, summarizes the direct and indirect effects of Alternatives 1-5 on spectacled and Steller's eiders as predicted in Section 4.7 of this SEIS.

External Factors and Consequences

Past external effects were identified for damage to benthic habitat from foreign fisheries but little is known of the actual extent of the damage. Present and predicted impacts on benthic habitat from external fisheries are considered negligible.

Table 4.13-36 summarizes the direct and indirect effects of the pertinent external effects on spectacled and Steller's eiders in the BSAI and GOA.

Analysis and Significance of Cumulative Effects

Only one fisheries-related cumulative impact was identified for eiders. Potential damage to eider critical habitat areas was identified but considered insignificant due to the limited amount of overlap with benthic trawl fisheries of any kind.

Table 4.13-36 summarizes the cumulative impact assessment for these eider species.

Table 4.13-32 Northern Fulmars

Alternative 1- Past Influence

Direct/Indirect Effects of Groundfish Fishery	External Effects						Past Influence? Y/N
	Human Controlled			Natural Events			
Category	Foreign Fisheries	State Fisheries	Halibut Fishery	Short-term Climate	Long-term Climate	Regime Shift	
Take	-	-	-	0	0	0	Y-
Prey Availability	0	0	0	+ / -	+ / -	+ / -	Y+/-
Processing Waste and Offal	-	-	-	0	0	0	Y-

Alternative 1, 3, 4, and 5- Present/Predicted Effects

Direct/Indirect Effects of Groundfish Fishery		Rating	External Effects							Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Alt. 1,3,4,5	Human Controlled	Natural Events			Regime Shift					
		Foreign Fisheries	State Fisheries	Halibut Fishery	Short-term Climate		Long-term Climate				
Take - BSAI	U	-	-	-	0	0	0	Y	N		
Take - GOA	I	-	-	-	0	0	0	Y	N		
Prey Availability	I*	0	0	0	+/-	+/-	+/-	N			
Processing Waste and Offal	CS(+)	-	-	-	0	0	0	Y	N		

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
Notes: *negligible, essentially no effect

Table 4.13-32 Northern Fulmars (Cont.)

Alternative 2 - Present/Predicted Effects

Direct/Indirect Effects of Groundfish Fishery		Rating
Category		Alt. 2
Take - BSAI		I
Take - GOA		I
Prey Availability		I*
Processing Waste and Offal		I

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
 Notes: *negligible, essentially no effect

External Effects					
Human Controlled			Natural Events		
Foreign Fisheries	State Fisheries	Halibut Fishery	Short-term Climate	Long-term Climate	Regime Shift
-	-	-	0	0	0
-	-	-	0	0	0
0	0	0	+/-	+/-	+/-
-	-	-	0	0	0

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	N
Y	N
N	
Y	N

Table 4.13-33 Short-Tailed Albatross

Alternative 1 - Past Influence

Direct/Indirect Effects of Groundfish Fishery	External Effects							Past Influence? Y/N
	Human Controlled			Natural Events				
	Foreign Fisheries	State Fisheries	Halibut Fishery (IPHC)	Short-term Climate	Long-term Climate	Regime Shift		
Take	-	-	0	0	0	0	0	Y-
Prey Availability	0	0	0	+/-	+/-	+/-	+/-	Y
Processing Waste and Offal	0	0	0	0	0	0	0	N

Alternative 1 - Present/Predicted Effects

Direct/Indirect Effects of Groundfish Fishery		External Effects							Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled			Natural Events					
	ALT. 1	Foreign Fisheries	State Fisheries	Halibut Fishery (IPHC)	Short-term Climate	Long-term Climate	Regime Shift			
Take			-	-	0	0	0	0	Y	Y-
Prey Availability			0	0	0	+/-	+/-	+/-	N	
Processing Waste and Offal			0	0	0	0	0	0	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *negligible, essentially no effect

Table 4.13-34 Other Albatross and Shearwaters

Alternative 1 - Past Influence

Category	External Effects						
	Human Controlled			Natural Events			
	Foreign Fisheries	State Fisheries	Halibut Fishery (IPHC)	Short-term Climate	Long-term Climate	Regime Shift	Past Influence? Y/N
Take	-	-	-	0	0	0	
Prey Availability	0	0	0	+/-	+/-	+/-	
Processing Waste and Offal	-	-	-	0	0	0	

Alternative 1 - Present/Predicted Effects

Category	Rating	External Effects						
		Human Controlled			Natural Events			
		Foreign Fisheries	State Fisheries	Halibut Fishery (IPHC)	Short-term Climate	Long-term Climate	Regime Shift	Cumulative Effect Y/N
Take	I	-	-	-	0	0	0	
Prey Availability	I*	0	0	0	+/-	+/-	+/-	
Processing Waste and Offal	I*	-	-	-	0	0	0	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative
 Notes: *negligible, essentially no effect.

Table 4.13-35 Piscivorous Seabirds

Alternative 1 - Past Influence

Direct/Indirect Effects of Groundfish Fishery		External Effects						Past Influence? Y/N
Category		Human Controlled		Halibut (IPHC)	Natural Events			
		Foreign Fisheries	Other Fisheries		Short-term Climate	Long-term Climate	Regime Shift	
Take		-	-	-	0	0	0	Y
Prey Availability		0	0	0	+/-	+/-	+/-	Y
Processing Waste and Offal		-	-	-	0	0	0	Y

Alternative 1 - Present/Predicted Effects

Direct/Indirect Effects of Groundfish Fishery		Rating
Category		Alt. 1
		I
		U
Take		I
Prey Availability		U
Processing Waste and Offal		I

External Effects					
Human Controlled			Natural Events		
Foreign Fisheries	Other Fisheries	Short-term Climate	Long-term Climate	Regime Shift	
-	-	0	0	0	
0	0	-	+/-	+/-	
-	-	0	0	0	

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	N
Y	N
Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-36 Eiders (Spectacled and Steller's)

Alternative 1 - Past Influence

Category	External Effects							Past Influence? Y/N
	Human Controlled						Regime Shift	
	Foreign/Joint Venture Fisheries	Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate			
Take	0	0	-	0	0	0	0	Y-
Prey availability	0	0	0	0	+/-	+/-	+/-	N
Benthic habitat damage	-	-	0	0	0	0	0	Y-

Alternative 1 - Past, Present and Predicted

Direct/Indirect Effects of Groundfish Fishery		Rating	External Effects							Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Alt. 1	Human Events		Natural Events			Regime Shift				
		Other Fisheries	Subsistence Harvest	Short-term Climate	Long-term Climate						
Take		I*	0	-	0	0	0	0	N		
Prey		I*	0	0	0	0	0	0	N		
Benthic habitat damage		I	-	0	0	0	0	0	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Notes: *negligible, essentially no effect

4.13.8 Benthic Habitat and Essential Fish Habitat

4.13.8.1 Summary of Affected Environment Factors

Essential fish habitat (EFH) is currently defined as those waters and substrate necessary for fish to spawn, breed, feed, or grow to maturity. By definition, EFH encompasses both benthic substrates and the water column, including aquatic areas and their associated physical, chemical, and biological properties that are used by fish. Non-benthic EFH incorporates the physical and chemical properties of the water column; its main biological component consists of any non-benthic prey of fish.

Habitat areas of particular concern (HAPC) are habitat types or areas that may require extra protection. HAPC is defined on the following criteria: its ecological importance, sensitivity, exposure, and rarity of the habitat. Three habitat types in Alaska meet all of the criteria species in the interim final rule, and were adopted as part of the five EFH amendments to Alaska's FMPs:

- Living substrata in shallow water
- Living substrata in deep water
- Freshwater areas used by anadromous fish.

Additional information describing EFH, HAPC and the effects of fishing on these habitats is provided in Section 3.8 of this SEIS.

While it is recognized that EFH encompasses both benthic and non-benthic habitat, this section deals only with the potential cumulative effects of the alternatives on benthic EFH because only the effects on marine benthic habitat are considered in Section 4.8. Cumulative impacts of the alternatives on target fish, non-specified fish, and forage fish (which by definition are included as the biological component of EFH) are considered in Sections 4.13.2, 4.13.3, and 4.13.4, respectively.

Direct and indirect impacts of the alternatives on benthic EFH in the Bering Sea and Gulf of Alaska (GOA) have been assessed in Section 4.8. Four direct and one indirect effects were considered:

Direct Effects:

- Damage to or removal of Habitat Areas of Particular Concern (HAPC) biota by trawl gear
- Damage to or removal of HAPC biota by fixed gear
- Modification of nonliving substrate, and/or damage to small epifauna and infauna by trawl gear

Indirect Effect:

- Reduction in benthic biodiversity

In Section 4.8, these direct and indirect effects on EFH are rated for Alternatives 1-5.

4.13.8.2 Summary of External Factors and Consequences

As described in Section 4.13, the cumulative effects analysis must take into considerations actions that are external to the groundfish fisheries. A discussion of the external effects screened for cumulative effects analyses is presented in Section 4.13. The external effects determined to be applicable to the benthic EFH cumulative effects analyses include the following:

Past External Effects

- Foreign Fisheries - employing mobile gear.
- Other Fisheries - joint venture (JV) and domestic groundfish fisheries employing mobile gear State of Alaska managed fisheries employing both mobile and fixed-gear, the IPHC managed halibut fishery employing fixed-gear.
- Subsistence fisheries - generally employing fixed-gear.
- Wind generated waves.
- Climate effects - short-term, long-term, and regime shift.

Present and Predicted External Effects:

- Other fisheries - State of Alaska managed fisheries employing both mobile and fixed-gear (e.g., scallop, flatfish sablefish and Pacific cod, and crab pot fisheries), the IPHC managed halibut fishery employing fixed-gear.
- Subsistence fisheries - generally employing fixed-gear.
- Wind generated waves.
- Climate effects - short-term, long-term, and regime shift.

Table 4.13-37, which follows this section, provides a summary of the alternative ratings and the addition of beneficial or adverse external effects. The table was developed following the approach outlined in Section 4.13. The geographic scope of effects considered in Section 4.8 and brought forward to Table 4.13-37 includes both the BSAI and the GOA.

As shown on Table 4.13-37, foreign fisheries and other fisheries (state, JV, and domestic) using both mobile (bottom trawling) and fixed (pots and longlining gear) are identified to have had a past negative influence on the reduction/destruction of HAPC (NMFS 2001a). The negative impacts are in the form of intense bottom trawling which directly destroys the HAPC.

The State of Alaska scallop dredge fishery which began in the Kodiak Island and Yakutat waters in 1967 also has the potential to impart negative impacts to benthic habitat. Since the 1970s Cook Inlet, Alaska Peninsula, and the eastern Aleutian waters have been explored, and scallop fisheries have decreased. The Alaska scallop fishery has a history of being sporadic due to exploitation of limited stocks, market conditions, and the availability of more lucrative fisheries. Annual catches for the state averaged 800,000 pounds shucked weight with an average value of approximately \$1 million (<http://www.state.ak.us/adfg/notebook/shellfish/scallop.htm>). In 1999, only three boats fished for scallops.² While the effect on benthic habitat of the dredging is intense, the magnitude of the overall impact of this fishery is likely to be small.

Fixed-gear can damage HAPC biota by hooking and by crushing plowing from pots and anchors. Groundlines can shear sessile organisms from the bottom upon retrieval. These actions also have had an indirect negative influence on benthic biodiversity.

Subsistence fishing, which generally uses fixed-gear, is found to have had a negative influence on both HAPC and non-living substrate. Foreign and other fisheries using both mobile and fixed-gear were rated as “+/-” because the gear could potentially enhance the food supply to the water column by stirring up the bottom (Churchill 1989, see Section 3.2.1 of the SEIS). Effects, both beneficial and negative, would probably be

²B. Bechtohl, “Personal Communication,” Alaska Department of Fish and Game, P.O. Box 25526, Juneau, AK 99802.

greater in the deep ocean where the seabed is relatively unaffected by natural disturbances, but minimal in areas with significant current or tidal transport, because organisms in such areas are adapted to disturbance (ICES 1988, Jones 1992, see Section 3.2.1 of the SEIS). The natural effect of wind induced waves is rated similarly ("+/") for the same reason. For example, in the EBS, winter storms, whose effects are in some ways similar to those of trawling, are capable of moving fine sands from waters as deep as 94 m (Sharma et al. 1972, see Section 3.2.1 of the SEIS).

The effects of climate change and regime shift on HAPC and benthic biodiversity are not understood at this time, and are therefore given a rating of unknown. However, it is logical to assume that these natural effects did not influence non-living substrate.

External effects associated with the Status quo are depicted on Table 4.13-37. Many of these effects are the same as those described above with the exception of foreign fisheries that are no longer of concern.

4.13.8.3 Analysis and Significance of Cumulative Effects

Alternatives 1 and 5

Under Alternative 1, about 14% of critical habitat would be closed to trawling year round. There also would be restrictions on the Atka mackerel fishery. For Alternative 5, closures to all trawling would be the same as Alternative 1. Cumulative effects were identified for all effect categories, and four of the five cumulative effects are considered to be conditionally significant adverse (see Table 4.13-37).

A past adverse influence of external effects as described above is identified for the destruction of HAPC and modification of non-living substrate by mobile and fixed gear, and for the indirect effects on changes to species diversity. Because of the known effects of trawling and fixed gear on the ocean floor as outlined in Section 3.8, the effect of Alternatives 1 and 5 on the categories of removal and damage by mobile gear, removal and damage by fixed gear, modification of non living substrate by mobile gear, and habitat subject to changes in biodiversity are rated as conditionally significant adverse. Impacts due to modification of substrate by fixed gear are determined to be insignificant under these alternatives. Additional justification for these ratings is provided in Sections 4.8.1 and 4.8.5.

Other fisheries, such as the State of Alaska managed fisheries employing mobile gear and subsistence fisheries that generally employ fixed gear, along with wind and wave action and climate change are identified as contributing external factors (Table 4.13-37). These external factors probably contribute incrementally adverse impacts to the HAPC and to species diversity. Therefore a conditionally significant adverse cumulative effect is identified for removal and damage to HAPC by mobile and fixed gear, modification of nonliving substrate by mobile gear, and for the indirect effect of changes to species diversity. Cumulative effects on epifauna and infauna due to modification of non-living substrate by fixed gear are not expected to be significant.

Alternative 2

This is the most protective alternative being considered in terms of reducing competition for prey with Steller sea lions, and is also the most protective for EFH. Alternative 2 would prohibit all trawling in critical habitat, while lowering the TAC limits for pollock, cod, and mackerel. It would also implement measures to spread the fishing effort over the entire year. Cumulative effects were identified for all effect categories, and one of the five cumulative effects is considered to be conditionally significant positive (see Table 4.13-37).

A past adverse influence of external effects as described above is identified for the destruction of HAPC and modification of non-living substrate by mobile and fixed gear, and for the indirect effects on changes to

species diversity. This alternative closes a large area to trawling while also reducing the TAC; therefore increased fishing effort outside of the closed area and potential damage to benthic substrates will not occur under Alternative 2. The alternative is rated as significantly positive for this protection to HAPC due to the reduction in potential damage from mobile gear. For the categories of damage to HAPC by fixed gear, modification of nonliving substrate by mobile gear, and habitat subjected to biodiversity changes, the rating is judged to be conditionally significant beneficial. However, the impact of the alternative on modification to substrate by fixed gear is expected to be insignificant. Additional justification for these ratings is provided in Section 4.8.2.

Other fisheries, such as the State of Alaska managed fisheries employing mobile gear and subsistence fisheries that generally employ fixed gear, along with wind and wave action and climate change are identified as contributing external factors (Table 4.13-37). These external factors probably contribute incrementally adverse impacts to the HAPC and to species diversity. For the category of removal and damage to HAPC by mobile gear, the extensive protection to benthic habitat provided by this alternative is judged to be sufficient to override any negative impacts of the external effects. Therefore a conditionally significant beneficial cumulative effect is identified for this category (see Table 4.13-37). For the categories of removal and damage of HAPC by fixed gear, modification of nonliving substrate by mobile gear, and overall changes to species diversity, it is possible that these potentially adverse external effects would be somewhat mitigated by the potentially beneficial effects of Alternative 2. Therefore, the cumulative effects for the remaining four categories, the cumulative effects are judged to be insignificant.

Alternative 3

Alternative 3 would establish large areas of critical habitat where fishing for pollock, cod, and mackerel is prohibited, and would restrict catch levels in remaining critical habitat areas. A significant portion of critical habitat (63.7%) would be closed to trawling. Cumulative effects were identified for all effect categories; however, none of the cumulative effects are predicted to be conditionally significant (see Table 4.13-37).

A past adverse influence of external effects as described above is identified for the destruction of HAPC and modification of non-living substrate by mobile and fixed gear, and for the indirect effects on changes to species diversity. Alternative 3 would close a significant portion of critical habitat to trawling. Under the assumption that a substantial increase in the area protected from trawling would benefit EFH, then this alternative would benefit EFH on balance and is rated conditionally significant positive for removal and damage to HAPC species from trawling and longlining. For modification to living substrates by mobile gear, and for potential biodiversity changes, the alternative is also rated as CS+. However, the effects of the alternative are expected to be insignificant for modification of non-living substrate due to fixed gear (see Table 4.13-37). Additional justification for these ratings is provided in Section 4.8.3.

Other fisheries, such as the State of Alaska managed fisheries employing mobile gear and subsistence fisheries that generally employ fixed gear, along with wind and wave action and climate change are identified as contributing external factors (Table 4.13-37). These external factors probably contribute incrementally adverse impacts to the HAPC and to species diversity. It is possible that these potentially adverse external effects would be somewhat mitigated by the potentially beneficial effects of Alternative 3. Therefore, the cumulative effects for all categories are judged to be insignificant (see Table 4.13-37).

Alternative 4

This alternative includes complicated fishery specific closures, with seasonal and catch apportionments for each fishery in each region. From the perspective of habitat protection, the most relevant management measures are those that involve general fishing area closures and area specific gear (particularly trawl gear) closures. These measures are outlined in the description of the alternatives contained in Section 2.3. A management scheme with such a complex network of closures on a fishery by fishery basis is not particularly beneficial to habitat, which is protected best by complete closures. Cumulative effects were identified for all effect categories under this alternative (see Table 4.13-37). Cumulative effects associated with damage and/or removal of HAPC by mobile and fixed gear were determined to be conditionally significant adverse, while cumulative effects associated with damage to non-living substrate by any type of gear, and changes to overall species diversity were judged as insignificant.

A past adverse influence of external effects as described above is identified for the destruction of HAPC and modification of non-living substrate by mobile and fixed gear, and for the indirect effects on changes to species diversity. Alternative 4 offers less protection than Alternatives 2 and 3, but more than Alternatives 1 and 5. Alternative 4 is rated as conditionally significant adverse for removal and damage to HAPC by bottom trawl and fixed gear. Although the alternative does provide protection for habitat in some areas, this protection will be offset by additional damage in other areas, leading to the CS- designation. Modification of non-living substrate by mobile and fixed gear, and changes to biodiversity are rated as insignificant. Additional justification for these ratings is provided in Section 4.8.3.

Other fisheries, such as the State of Alaska managed fisheries employing mobile gear and subsistence fisheries that generally employ fixed gear, along with wind and wave action and climate change are identified as contributing external factors (Table 4.13-37). These external factors probably contribute incrementally adverse impacts to the HAPC and to species diversity. Therefore, cumulative effects are identified for all categories. For the categories of removal and damage to HAPC by fixed and mobile gear, the cumulative effects are rated as conditionally significant adverse. For the categories of modification of nonliving substrate by mobile and fixed gear, and impacts to species diversity the cumulative effects are judged to be insignificant (see Table 4.13-37).

Table 4.13-37 Marine Benthic Habitat - Cumulative Effects

Past Effects

Category
Direct/Indirect Effects of Groundfish Fishery
Removal and damage to HAPC by Mobile gear
Removal and damage to HAPC biota by Fixed-gear
Modification of non-living substrate, damage to epifauna and infauna by mobile gear
Modification of non-living substrate, damage to epifauna and infauna by fixed-gear
Changes to Species Mix

External Effects						
Human Controlled			Natural Events			
Foreign Fisheries	Other Fisheries	Subsistence	Wind induced waves	Short-term Climate	Long-term Climate	Regime Shift
-	-	0	+/-	U	U	U
-	-	-	+/-	U	U	U
+/-	+/-	0	+/-	0	0	0
+/-	+/-	-	+/-	0	0	0
-	-	0	+/-	U	U	U

Past Influence? Y/N
Y
Y
Y
Y
Y

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-37 Marine Benthic Habitat - Cumulative Effects (Cont.)

Alternatives 1 and 5

Direct/Indirect Effects of Groundfish Fishery		External Effects								Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events								
		Other Fisheries	Subsistence	Wind induced waves	Short-term Climate	Long-term Climate	Regime Shift					
Removal and damage to HAPC by Mobile gear	CS-	-	0	+/-	U	U	U		Y	Y	Y-	
Removal and damage to HAPC by Fixed-gear	CS-	-	-	+/-	U	U	U		Y	Y	Y-	
Modification of non-living substrate, damage to epifauna and infauna by mobile gear	CS-	-	0	+/-	0	0	0		Y	Y	Y-	
Modification of non-living substrate, damage to epifauna and infauna by fixed-gear	I	-	-	+/-	0	0	0		Y	Y	N	
Habitat Subject to Biodiversity Reduction	CS-	-	U	+/-	U	U	U		U	Y	Y-	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-37 Marine Benthic Habitat - Cumulative Effects (Cont.)

Alternative 2

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N	
Category	Rating	Human Controlled		Natural Events			Wind induced waves	Short-term Climate	Long-term Climate	Regime Shift		
		Other Fisheries	Subsistence									
Removal and damage to HAPC by Mobile gear	S+	-	0	+/-	U	U		U		U	Y	Y+
Removal and damage to HAPC by Fixed-gear	CS+	-	-	+/-	U	U		U		U	Y	N
Modification of non-living substrate, damage to epifauna and infauna by mobile gear	CS+	-	0	+/-	0	0		0		0	Y	N
Modification of non-living substrate, damage to epifauna and infauna by fixed-gear	I	-	-	+/-	0	0		0		0	Y	N
Habitat Subject to Biodiversity Reduction	CS+	-	U	+/-	U	U		U		U	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-37 Marine Benthic Habitat - Cumulative Effects (Cont.)

Alternative 3

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events							
		Other Fisheries	Subsistence	Wind induced waves	Short-term Climate	Long-term Climate	Regime Shift				
Removal and damage to HAPC by Mobile gear	CS+	-	0	+/-	U	U	U	Y	Y	N	
Removal and damage to HAPC by Fixed-gear	CS+	-	-	+/-	U	U	U	Y	Y	N	
Modification of non-living substrate, damage to epifauna and infauna by mobile gear	CS+	-	0	+/-	0	0	0	Y	Y	N	
Modification of non-living substrate, damage to epifauna and infauna by fixed-gear	I	-	-	+/-	0	0	0	Y	Y	N	
Habitat Subject to Biodiversity Reduction	CS+	-	U	+/-	U	U	U	U	Y	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-37 Marine Benthic Habitat - Cumulative Effects (Cont.)

Alternative 4

Direct/Indirect Effects of Groundfish Fishery		External Effects							Past Influence Y/N	Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events			Regime Shift				
		Other Fisheries	Subsistence	Wind induced waves	Short-term Climate	Long-term Climate					
Removal and damage to HAPC by Mobile gear	CS-	-	0	+/-	U	U	U		Y	Y-	
Removal and damage to HAPC by Fixed-gear	CS-	-	-	+/-	U	U	U		Y	Y-	
Modification of non-living substrate, damage to epifauna and infauna by mobile gear	I	-	0	+/-	0	0	0		Y	N	
Modification of non-living substrate, damage to epifauna and infauna by fixed-gear	I	-	-	+/-	0	0	0		Y	N	
Habitat Subject to Biodiversity Reduction	I	-	U	+/-	U	U	U		U	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.9 Ecosystem

This section examines the potential of the alternatives, in combination with external factors, to produce cumulative effects at the ecosystem level. The discussions are based on the ecosystem issues discussed in Section 3.9 and on the potential direct and indirect effects of the alternatives identified in Section 4.9, acting in an additive or synergistic fashion with external influences. The cumulative effects analysis followed the approach described in Section 4.13.

4.13.9.1 Summary of Affected Environment Factors

Sections 3.9.1 and 3.9.2 describe the affected environments of the BSAI and GOA ecosystems, respectively. The following summary identifies features of the affected environment that are particularly relevant to assessing potential cumulative effects at the ecosystem level. A detailed discussion of these geophysical influences is available in Section 3.1 of the Groundfish Draft Programmatic SEIS and is incorporated here by reference (NMFS 2001a).

The BSAI environment has several distinctive features that strongly influence ecosystem parameters. The Bering Sea is semi-enclosed by the Asian and North American land masses to the west and east, respectively, and by the 2,575 km chain of the Aleutian Islands to the south. Pack ice, advancing and receding with the seasons, acts as an additional boundary to the north. These physical constraints create a 2.3 million km² marine enclave with gulf-like characteristics distinctive from other portions of the North Pacific Ocean.

About 44 percent of the area of the Bering Sea is underlain by continental shelf, providing an extensive, relatively flat and shallow sea floor. This shallow character, in combination with the semi-enclosed nature of the Bering Sea, leads to a consistent and predictable seawater circulatory pattern. The Alaskan Stream enters the Bering Sea from the North Pacific through passes between the Aleutian Islands (Favorite et al. 1976). Water is transported eastward along the north side of the Aleutian chain to the eastern portion of Bristol Bay, where it is directed northward along the Alaskan coast. Some water leaves the BSAI basin through the Bering Strait, whereas other water continues westward and south along the Siberian coast, finally re-entering the western North Pacific through the Kamchatka Strait. Some of the exiting water is entrained by the Alaskan Stream, re-entering the Bering Sea basin along with a preponderance of new water from the North Pacific. This pattern sustains a perpetual gyre that circles the perimeter of the Bering Sea. The consistent counter-clockwise flow of continuously replenished seawater over the shallow plain of the sea floor creates a stable and biologically productive environment that—particularly in the eastern Bering Sea where the continental shelf is most extensive—supports some of the largest and economically important commercial fisheries in the world.

The enclosed, shallow nature of the Bering Sea basin renders the marine environment susceptible to dynamic and seasonally changing weather patterns and longer-term climatic trends. Weather of the North Pacific region shows a consistent pattern of seasonal variation from year to year. During the winter, recurring low pressure systems, with counter-clockwise air movements from the southeast, dominate the region. In summer the pattern reverses, and the North Pacific high pressure system shifts northwestward into the central Aleutian region, propelling heavy, dry air clockwise from the southwest across the Aleutians and into the Bering Sea, intensifying the Bering Sea gyre. In addition to this annually recurring seasonal pattern, longer term climatic regime shifts occur. Evidence indicates that periodic events such as the El Niño phenomenon and decadal oscillations produce atmospheric forcing with pronounced effects on the BAI ecosystem (Francis et al. 1999, Hare and Mantua 2000). For example, a large increase in some jellyfish populations in the Bering Sea has been linked to a climatic regime shift (Brodeur et al. 1999), and recruitment rates in crab and groundfish populations have been associated with climatic factors (Zheng and Kruse 1998, Rosenkranz et al. 1998, Hollowed et al. 1998, Hare and Mantua 2000).

In contrast to the Bering Sea, the GOA has a narrow continental shelf component that totals about 160,000 km², less than 25 percent of the eastern Bering Sea Shelf. The GOA is a more open marine environment, bounded by the continental land mass to the east and north but continuous with the North Pacific Ocean to the south and west. The dominant circulatory pattern in the GOA is the Alaska Gyre, which flows counter-clockwise and northward along the Alaskan coast. Seasonal variations in the position of the Pacific High and in local weather patterns produce variations in nearshore flows and eddies that increase the potential for biological variability within the GOA ecosystem.

Mueter (1999) found differences in the species abundance, richness, and diversity of GOA groundfish communities correlating to such variables as depth, temperature, salinity, sediment composition, and year of sampling. Species richness and diversity were greatest at water depths in the 200-300 m range, and higher abundance, lower species richness and diversity, and a different demersal species composition were found in the western GOA as compared to the eastern GOA. These large-scale differences were concluded to be related to differences in upwelling characteristics between the two regions. Increases in total groundfish biomass were measured from 1984 through 1996, along with changes in species composition. Since 1996, however, total groundfish biomass appears to have declined (NPFMC 2000d). These upward and downward trends may be related to variations in the Alaska Coastal Current that produce corresponding variations in the availability of nutrients and planktonic forage.

Anderson and Piatt (1999) analyzed the degree of correlation between climatic regime shifts occurring over ten-year intervals and species diversity and biomass data from commercial catches. They found that when the Aleutian low pressure system was weak, shrimp dominated the catches, whereas when the Aleutian Low was strong, cod, pollock, and flatfish dominated the catches as measured by biomass. These differences were attributed to climatically forced variations in water temperature: the weaker low pressure intervals were correlated with colder water and the stronger low pressure periods with higher temperatures. The authors concluded that biological variations on such a large geographic scale, and across so many taxa, suggest that climate change has a powerful influence on the GOA ecosystem.

4.13.9.2 Summary of External Factors and Consequences

External effects screened for the cumulative effects analyses are summarized in Section 4.13. These external influences fall into two categories: (1) human-controlled events and (2) natural events. The human controlled events considered in the ecosystem analysis are:

- Past External Effects:
 - Foreign fisheries catch & bycatch;
 - Joint venture (JV) and domestic fisheries bycatch;
 - State fisheries catch and bycatch;
 - International Pacific Halibut Commission (IPHC) catch (halibut only);
 - Resource development (salmon only);
 - Exxon Valdez Oil Spill (EVOS; herring in GOA only); and
 - Commercial shipping.
- Present and Predicted External Effects:
 - IPHC Halibut Fishery catch (halibut only); and
 - State fisheries catch & bycatch

Natural events considered are:

- Short-term climate change (e.g., the El Niño/Southern Oscillation [ENSO] phenomenon);
- Long-term climate changes (e.g., Pacific Decadal Oscillations and global warming); and
- Regime shifts (influenced primarily by long-term climate changes).

Four categories of conditionally significant cumulative effects on the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI) ecosystems were identified for some or all of the alternatives:

- Pelagic forage availability;
- Spatial/temporal concentration of the fishery on forage;
- Introduction of non-indigenous species; and
- Species diversity.

These are the parameters relevant to marine ecosystem diversity and stability that are most likely to be affected by the alternatives acting in combination with the human-controlled and natural external effects listed above.

For the ecosystem analysis, a significant cumulative effect is defined as one that would alter the diversity or stability of the BSAI or GOA ecosystem by (1) affecting predator-prey relationships; (2) adding or removing energy and redirecting pathways of energy flow; or (3) increasing or decreasing biodiversity as measured by species, trophic function, or genetics.

As explained in Section 4.13, potential cumulative effects that satisfy significance criteria are labeled as conditionally significant. This term recognizes that our ability to demonstrate existing cumulative effects or to predict such effects in the future is not reliable enough to allow any degree of certainty to be attached to the outcome. Especially at the ecosystem level, available data regarding predator-prey relationships, energy flow and balance, and diversity are insufficient to allow dependable characterization of existing conditions. Predicting future outcomes is inherently unreliable, not only because of our absolute uncertainty about the future, but also because the influence of poorly predictable climatic factors on the BSAI and GOA ecosystems outweighs effects that might result from human activities planned for the reasonably foreseeable future.

Conditionally significant cumulative effects of the alternatives on the BSAI and GOA ecosystems are summarized in Table 4-13-10-1, which indicates the basic structure for the remainder of this discussion. The three major subsections are organized by predator-prey relationships (Section 4.13.9.2), energy flow and balance (Section 4.13.9.3), and diversity (Section 4.13.9.4). In each of these subsections, potential cumulative effects (corresponding to the cells in Table 8.1-1) are discussed for each alternative, with greater emphasis on those evaluated as conditionally significant. SEIS Section 4.13.9.5 summarizes the alternatives with respect to their potential to produce conditionally significant cumulative effects on the BSAI and GOA ecosystems.

4.13.9.3 Summary of Cumulative Effects

Predator-Prey Relationships

The characteristics of predator/prey interactions with the food web are an important determinant of ecosystem stability and diversity. These interactions can be affected by natural (usually climate-related) conditions and by human activities. Existing resource management policies in the BSAI and GOA have been implemented against the background of a relatively mature and resilient ecosystem that exhibits naturally occurring changes (see Section 4.9). These baseline patterns and trends, along with their probable forcing agents, must be recognized before any additive or synergistic influences of external factors acting with the alternatives can be identified and evaluated with respect to conditional significance. The following discussion first reviews information about naturally occurring background fluctuations in the BSAI and GOA ecosystems, i.e., changes that are not attributable to human activities and are essentially beyond human control. Second, ways in which human activities can affect predator-prey relationships in the marine environment, including past, present and predicted external influences on the BSAI and GOA ecosystems, are reviewed. Third, potential cumulative effects of the alternatives on predator-prey relationships are examined.

Changes in species composition, population size, guild and community structure, production, recruitment, geographic distribution, and biomass have been documented in the GOA and eastern Bering Sea regions (see Sections 3.9.1 and 3.9.2). The factors driving these changes are speculative, but decadal-scale climatic shifts and interannual climatic variations such as the El Niño phenomenon have been suggested as forcing agents (McGowan et al. 1998). For example, increases in zooplankton biomass and in salmon landings documented in the GOA have been correlated with the intensity and location of the winter mean Aleutian low pressure system, which changes on an interdecadal time scale (Francis and Hare 1994, McGowan et al. 1998, Orensanz 1998, Anderson and Piatt 1999, Robards et al. 1999). Beyond such correlations with climatic indices, cause-and-effect relationships between climatic and ecosystem changes have not been proven, but climate-related changes in physical oceanographic factors such as temperature, salinity, current patterns, upwellings, sediment composition, and nutrient supply have been implicated (e.g., Mueter 1999).

Fluctuations in species composition within guilds and in total guild biomass have been examined to determine if they might be correlated with fishing pressure on predator-prey cycles. Livingston et al. (1999) found that long-term increases and decreases in the abundance of selected eastern Bering Sea invertebrate, fish, bird, and marine mammal species did not show positive correlations with prey abundance, and that cyclic fluctuations in abundance occurred in both fished and unfished species. These researchers also found that changes in species diversity within guilds related to increases in a dominant guild member (e.g., pollock and rock sole) rather than to decreases in abundance caused by fishing pressure. It was concluded that the eastern Bering Sea ecosystem shows two indicators of stability: (1) the trophic level of the eastern Bering Sea harvest, after rising slightly since the 1950s, appears to be stable as of 1994, suggesting that present harvest levels are sustainable; and (2) the fish populations examined are stable, i.e., fluctuate normally without showing prolonged trends in a particular direction. These findings suggest that the eastern Bering Sea ecosystem is relatively stable and undergoes natural fluctuations that are driven by climatic cycles.

Human actions such as commercial fishing, superimposed on the naturally occurring background fluctuations discussed above, can affect predator-prey relationships in four main ways (see Section 4.9). If changes occur with respect to the amount of food (forage) available to predators at each level (or within each trophic guild) of the food web, the species composition and abundance of the predators can change. If fisheries concentrate their effort on specific locations and at specific times of the year, over-fishing of particular groups of forage fish can occur and in this way alter predator/prey relationships. Removal of top predators, continued by "fishing down the food web" to reduce predator populations at successively lower levels, can deplete predator populations and indirectly change the prey populations exploited by those predators. And the introduction of new prey or, more often, predatory species (mostly invertebrates) from other parts of the world can lead

to the introduced species out-competing and ultimately replacing the indigenous ones. Consequently, effects of human activities on BSAI and GOA predator/prey relationships are structured into the following four categories:

- *Pelagic forage availability*: Changing the availability of important forage (prey) species by selectively removing key predator or competing forage species from the food web;
- *Spatial and temporal concentration of fishery on forage*: Over-fishing of important forage species by concentrating the fishing effort in space (geographic location) and/or time;
- *Removal of top predators*: Removal of predators from the top and from successively lower levels of the food web (fishing down the food web); and
- *Introduction of nonnative species*: Introducing new (i.e., non-indigenous) competitor species into the food web.

Prior to passage and enforcement of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act), overfishing and depletion of groundfish, Pacific herring, and salmonid stocks by U.S., Soviet, and other fleets was considered to be a serious problem in the BSAI (Pautzke 1997). Pelagic forage availability was reduced by concentrated fishing efforts. In the "Donut Hole" in the central Bering Sea during the mid-1980s, for example, both spatial and temporal concentrations on forage occurred as foreign vessels from Japan, South Korea, Poland, and China converged into a localized area to fish pollock after these fleets were displaced from U.S. waters by the growth of U.S. domestic fisheries. Pollock catch rapidly increased in the Donut Hole at the start of this concentrated effort, and then declined even more rapidly (Pautzke 1997). A large foreign fishery for herring food products existed in the eastern Bering Sea in the 1960s and 1970s, until this activity was eliminated by the Magnuson-Stevens Act (ADF&G 2000a).

Removal of top predators has also occurred. Interceptions of U.S. and Canadian salmon stocks by Soviet and Japanese fleets, including offshore driftnet fisheries for salmon, were and continue to be an additional concern, particularly due to the high bycatch of marine mammals and sea birds by driftnets. Northern fur seals, a top predator species, were harvested until 1985 on the Pribilof Islands. Annual harvests during the period of 1980–1984 ranged between 22,000 and 26,000 seals, and a continuing population decline led to this species being listed as "depleted" under the Marine Mammal Protection Act (MMPA). Only seals needed for subsistence purposes are now taken (Zimmerman 1994). During many years prior to their Endangered Species Act (ESA) listing, Steller sea lions succumbed to direct mortality from illegal shooting.

Non-indigenous species such as the predatory seastar *Asterias amurensis* have been introduced to the BSAI and GOA environments through ballast water discharges from fishing vessels that participate in the federally managed groundfish fishery and from commercial transport and tourism vessels (see Section 4.9.1). Although there is no available evidence that marine species introduced into Alaskan waters have yet had an adverse effect on predator-prey relationships, there is always the potential that an introduced species could out-compete an indigenous species occupying the same ecological niche and eventually replace or endanger the indigenous species. It is also possible that an introduced species could exploit an unoccupied niche and change the food web by consuming previously unexploited or lightly utilized food sources.

These and other external influences from the past, acting along with the background climatic effects on pelagic forage availability discussed above, are considered to have produced lasting effects on existing predator-prey relationships in the BSAI and GOA. These effects are well recognized and are presently being mitigated through international agreements. For example, there has been an international moratorium on fishing in the Donut Hole since 1993, and the 1994 Convention on the Conservation of the Pollock Resources in the central Bering Sea established a formula for future harvests of pollock if or when renewed stock abundance allows such fisheries. With respect to salmon, the United States and Russia signed a bilateral agreement in 1992 to ban directed salmon fishing in the United States and Russian Exclusive Economic Zones (EEZs). One intent of this agreement is to avoid locations where North American and Asian stocks

intermingle. To this end, directed salmon fisheries are permitted within 25 nautical miles (nm) of the baseline from which each 200-mile zone is measured (Pautzke 1997).

At present, the major influence of other fisheries on pelagic forage availability comes from the Alaskan herring fishery, which is managed by the Alaska Department of Fish and Game (ADF&G). The Pacific herring, a planktivore, is a key component of pelagic and nearshore food webs in the BSAI and GOA and is an important food source for a wide variety of fishes, mammals, and birds. The principal commercial utilization of BSAI herring is for sac roe and for eggs on kelp, primarily for the Japanese market; herring carcasses are retained, frozen, and processed as fish meal. The 1999 harvest of herring for sac roe was approximately 38,000 mt, and the forecast for 2000 is about 40,000 mt (ADF&G 2000b). Subsistence removal of herring for food and bait in southeast Alaska, Prince William Sound, Kodiak, and Unalaska from September 1999 through July 2000 totaled 3,286 mt (ADF&G 2000c).

Space/time closures have recently been implemented to alleviate the effect of concentrated fishing in removing key forage fish. The 1994 international agreement closing the Donut Hole to pollock fishing, discussed above, is one example. Other closures have been implemented in response to the continuing, long-term decline in Steller sea lions and other predator species, with the intent of making a larger portion of forage fish populations available for predation. Paradoxically, both removing and increasing restrictions can lead to spatial and temporal concentrations of fishing effort. The former allows fishing to concentrate in locations and at times is likely to maximize catch per unit effort, whereas the latter, by its very nature, specifies when and where fish can be harvested. Thus closures may reduce concentrated fishing effort in some areas and increase it in others. Because spatial/temporal concentration cannot be avoided, the direct effect of Alternative 1 on forage availability is considered to be conditionally significant adverse. The additive effect of spatial/temporal concentrations by other fisheries and, to a minor extent, by subsistence harvests must reinforce this outcome to an unknown extent. Therefore, a conditionally significant adverse cumulative effect is concluded to result from spatial/temporal concentration of fisheries on forage species.

The potential direct and indirect effects of the status quo management regime in removing top predators through fishing down the food chain is not considered to be significant (see Section 4.9.2 of the SEIS). Although other fisheries remove salmon and halibut, all predatory species, there is no available evidence that depletions of these predators have interacted with Alternative 1 in an additive or synergistic way to measurably alter predator-prey relationships within the BAI and GOA food webs. Therefore, any cumulative effect that might result from such interactions is considered to not be significant.

Ballast water is discharged into Alaskan waters by fishing vessels, commercial tankers and cargo ships, and tourist ships. This external influence creates a potential for non-indigenous marine species, particularly invertebrate predators such as *Asterias amurensis*, to be introduced or augmented in the BAI and GOA (see Section 4.9.1). To date, introduced marine species have not been demonstrated to dominate any ecological niche, thus altering predator-prey relationships, within these two ecosystems.

As shown in Table 4.13.9-1, all of the alternatives were concluded to have the potential to produce a conditionally significant cumulative effect on pelagic forage availability. As explained in Section 4.9.1, even under Alternative 1, No Action, and with current fishery management policies in effect, total pollock and mackerel biomass is projected to remain stable in the BAI and to increase by over 40% in the GOA from 2001 to 2006. Alternatives 2 through 5 would augment this expected natural increase in pelagic forage fish biomass by lowering TACs for pollock, cod, and mackerel (Alternative 2), establishing critical habitat areas where commercial fishing for these species would be prohibited or limited (Alternative 3), defining restricted and closed areas with area-specific management flexibility, including seasonal limits and catch apportionments (Alternative 4), or limiting the catch of forage fish within critical sea lion habitat areas in proportion to estimated fish (pelagic forage) biomass (Alternative 5). From a cumulative standpoint, a conditionally significant positive effect would occur if the expected increase in pelagic forage availability

was enhanced by favorable climatic conditions and regime shifts. On the other hand, because these powerful forcing agents are likely to determine the overall availability of forage species in the GOA and BAI, the conditionally significant cumulative effect on pelagic forage associated with any of the alternatives could be beneficial or adverse (+/-), or neutral, depending on largely unpredictable climate and regime trends.

With respect to the spatial and temporal concentration of the commercial fishery on forage species such as pollock, cod, and mackerel, climatic trends would not be a major external influence. Instead, the additive or synergistic effect of bycatch mortality by the IPHC, foreign, JV, and domestic fisheries would be more influential. In addition to bycatch removals, the Alaskan herring fishery, which is managed by the Alaska Department of Fish and Game (ADF&G), exerts a substantial influence on pelagic forage availability. The Pacific herring, a planktivore, is a key component of pelagic and nearshore food webs in the BAI and GOA environments and is an important food source for a wide variety of fishes, mammals, and birds. In light of the annual targeted removal of herring and the loss of other forage biomass through bycatch mortality, spatial and temporal effects of fishing effort are concluded to exert an adverse influence on the overall availability of pelagic forage in the two ecosystems, as represented by (-) in Table 4.13.9-1. For Alternative 1, a conditionally significant adverse cumulative effect is predicted because this alternative would not ameliorate existing direct and indirect adverse effects, rated CS(-), of spatial and temporal fishery concentrations on pelagic forage. In contrast, Alternatives 2 through 5 would conditionally reduce spatial and temporal fishing pressures on forage species, as indicated by the CS(+) rating. Because this potential benefit would be offset to an unknown extent through forage removals by other fisheries, as discussed above, no net cumulative effect is predicted.

The potential direct and indirect effects of the five alternatives in removing top predators were not considered to be significant, and although other fisheries remove salmon and halibut, all predatory species, there is no evidence that regulated fishing removals of these predators would interact with any of the alternatives to alter predator/prey relationships within the GOA and BAI food webs. Therefore, no cumulative effect was predicted for this impact category.

As shown in Table 4.13.9-1, Alternative 1 was predicted to have conditionally significant adverse cumulative effect associated with the introduction of non-native, or non-indigenous, species. This is because existing introductions and augmentations of exotic species through ballast water discharge and hull-fouling organisms would not diminish under the No Action alternative, and the current potential for this alternative to have an additive or synergistic effect with foreign and other commercial fishing vessels and with commercial shipping would continue. Because Alternatives 2 through 5 are not concluded to have a significant direct or indirect effect in this regard, no cumulative effect is predicted.

Table 4.13-38 Cumulative Effects Summary – Predator-Prey Relationships

Past Effects

Direct/Indirect Effects	External Effects					Past Influence Y/N
	Human Controlled				Natural Events	
	IPHC Fishery	Foreign Fisheries	JV & Domestic Fisheries	Commercial Shipping	Climate & Regime Shifts	
Pelagic forage availability	-	-	-	0	+/-	Y
Spatial and temporal concentration of fishery on forage	-	-	-	0	0	Y
Removal of top predators	-	-	-	0	0	Y
Introduction of nonnative species	-	-	0	-	0	Y

Alternative 1

Direct/Indirect Effects		External Effects			Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events		
		IPHC, Foreign, Domestic & JV Fisheries	Commercial Shipping	Climate & Regime Shifts		
Pelagic forage availability	S(+)	-	0	+/-	Y	Y(+/-)
Spatial and temporal concentration of fishery on forage	CS(-)	-	0	0	Y	Y(-)
Removal of top predators	NS	-	0	0	N	
Introduction of nonnative species	CS(-)	-	-	0	Y	Y(-)

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-38 Cumulative Effects Summary – Predator-Prey Relationships (Continued)

Alternatives 2 through 5

Direct/Indirect Effects		External Effects			Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events		
		IPHC, Foreign, Domestic & JV Fisheries	Commercial Shipping	Climate & Regime Shifts		
Pelagic forage availability	S(+)	-	0	+/-	Y	Y(+/-)
Spatial and temporal concentration of fishery on forage	CS(+)	-	0	0	N	
Removal of top predators	NS	-	0	0	N	
Introduction of nonnative species	NS	- ¹	-	0	N	

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Energy Flow and Balance

As discussed in Section 4.9, high-volume fishing and fish processing can alter the amount and flow of energy in an ecosystem by removing energy in the form of biomass (i.e., large numbers of fish) and by altering pathways of energy flow through the return of discards and processing waste to the sea. When fish are removed from the marine ecosystem, the total energy content of the ecosystem is reduced. And when bycatch and processed wastes are returned to the sea, energy is redirected to different parts of the marine ecosystem relative to the natural state. If the quantities of biomass removed from the sea and/or returned in different form are large enough relative to the total biomass of the ecosystem, the energy balance of the system could be destabilized.

The energy balance and pathways of energy flow within the BSAI and GOA ecosystems are not significantly redirected by biomass removals and discarded fish bycatch and processing wastes that are returned to the sea. Total fishing removals of groundfish biomass are such a small proportion of the total system energy budget, and are so small relative to interannual variability in production, that variations in biomass removal are not significant. A similar situation applies to the discarding of bycatch and fish processing wastes to the sea. Available evidence (see Section 4.9) indicates that energy flow pathways are not significantly re-directed by the discarding of fish processing waste, and estimates regarding the level of discarded material relative to natural sources of detritus indicate that the aggregate of discarded biomass is insignificant in comparison to the background level of dead organic matter, although local concentrations can produce changes in nutrient levels and species composition. For this reason, the direct and indirect effects of energy removal and redirection on the BSAI and GOA ecosystems are concluded to be not significant (see Table 4.9-3). The remaining question is whether the cumulative effect of the alternatives acting in combination with external influences would be large enough to make energy removal and redirection significant. The answer, discussed in the following subsections, is that adding the incremental influence of the alternatives still would not lead to a significant effect on energy flow and balance at the ecosystem level.

In the past, various commercial fisheries operating in the BSAI and GOA regions have both removed and redirected energy through targeted fishing effort, bycatch discards, and waste processing. In 1996 and 1997, the North Pacific Fishery Management Council adopted BSAI Amendment 49 and GOA Amendment 49, respectively. These measures were intended to reduce the total biomass of discards by requiring improved retention and improved utilization for all groundfish target fisheries. Prior to passage of the amendments, it was determined that four species—walleye pollock, Pacific cod, rock sole, and yellowfin sole—represented approximately 76 percent of the total discards of allocated groundfish in the BSAI groundfish fisheries and 33 percent in the GOA fisheries. Accordingly, both amendments required that all vessels fishing for groundfish retain all pollock and Pacific cod as of January 1, 1998, and further require that all rock sole and yellowfin sole be retained starting January 1, 2003. The measures have been effective in reducing discards. In the 1997 BSAI groundfish fishery, for example, a total of 258,000 metric tons (mt) of groundfish was discarded, including 22,100 mt of cod and 94,800 mt of pollock. In 1998, after the first year of passage of BSAI Amendment 49, these amounts were reduced to 4,300 mt of cod and 16,200 mt of pollock.

The second way in which commercial fisheries have influenced BSAI and GOA ecosystem energetics is by redirecting energy flow through the return of dead bycatch and fish processing waste to the marine environment. Fisheries managed by the State of Alaska and by the IPHC remove shellfish, shrimp, king crab, snow crab, Dungeness crab, halibut, sablefish, rockfish, herring, and salmon, with the latter usually predominating in terms of biomass of processing waste discharged back into the ecosystem. Processing waste discharged in 1999 by the top nine seafood processing facilities in Alaska (in terms of weight of seafood processed) covered under a National Pollutant Discharge Elimination System (NPDES) general permit as reported to the U.S. Environmental Protection Agency (EPA) totaled 58,427.2 mt (EPA 2000), representing an addition of about 23 percent over the total groundfish waste discharge estimate of 258,000 mt for 1997, at the outset of the Amendment 49 period.

Against natural background levels of total biomass and detritus, this increase is considered to be not significant in altering ecosystem stability or diversity, and available evidence does not indicate that such alterations have in fact resulted in the BSAI and GOA due to past and current seafood processing waste discharges. It should be noted, however, that such discharges have been found to produce local adverse effects on water quality, anaerobic conditions, and other habitat-related parameters, especially where facilities are grouped in close proximity in sheltered waters. It is also important to be aware that there are many other seafood processing facilities in the BSAI and GOA not covered by the NPDES general permit mentioned above (i.e., that have individual NPDES permits). In the aggregate, these smaller seasonal facilities, which process mostly salmon, may substantially outweigh the combined contribution of the facilities covered by the general permit. Waste discharge data are not readily available on these individual facilities, and their cumulative effect cannot be quantified on the basis of available evidence (F. Carroll, EPA, personal communication). Furthermore, not all of these facilities return seafood processing wastes to the sea; some screen the waste to 1 millimeter particles and reduce it to fish meal (EPA 2000).

Because commercial fisheries operate by removing biomass and returning a portion of it to the sea in different form, they have produced and continue to exert an adverse but non-significant external effect on energy flow and balance within the BSAI and GOA ecosystems, as indicated by (-) in Table 4.13.9-2. In the case of energy removal, naturally-occurring climatic trends and regime shifts also have the potential to increase or decrease commercial fishery catch, as indicated by (+/-). In combination with any of the alternatives, these external effects, along with continuing influences from the past, have the potential to produce adverse cumulative effects on energy removal and redirection. The cumulative increase or decrease in total catch biomass under any alternative, however, would not be significant against the background of total BSAI and GOA biomass levels and would be negligible in comparison to the influences that natural forcing agents would exert on these ecosystems in the absence of fishing. With respect to energy removal, therefore, the potential cumulative effects of all alternatives are evaluated as not significant.

With respect to energy redirection, none of the alternatives would be likely to increase the level of discards back to levels observed before the improved retention and utilization requirements were implemented. Since adverse effects of discards were not observed at the ecosystem level before the new requirements came into effect, it is concluded that the cumulative effects of the alternatives with respect to energy redirection would not be significant against the background of the total BSAI and GOA ecosystem energy budgets. These results are summarized in Table 4.13.9-2.

Table 4.13-39 Cumulative Effects Summary – Energy Flow and Balance

Past Effects

Direct/Indirect Effects		External Effects					Past Influence Y/N
Category		Human Controlled				Natural Events	
		IPHC Fishery	Foreign Fisheries	JV & Domestic Fisheries	Commercial Shipping	Climate & Regime Shifts	
Energy removal (catch)		-	-	-	0	+/-	Y
Energy redirection (bycatch discards and processing waste)		-	-	-	0	0	Y

Alternatives 1 through 5

Direct/Indirect Effects		External Effects			Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Rating	Human Controlled		Natural Events		
		IPHC, Foreign, Domestic & JV Fisheries	Commercial Shipping	Climate & Regime Shifts		
Energy removal (catch)	NS	-	0	+/-	Y	N
Energy redirection (bycatch discards and processing waste)	NS	-	0	0	Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Biological Diversity

Biological diversity, the third index of ecosystem health in addition to predator/prey relationships and energetics, is approached here in three ways. First, the diversity (number) of species in an ecosystem can change if fishing removes all individuals belonging to a single species from the system. Comparative abundance of species, another aspect of species diversity, can change if fishing alters the numbers of individual representatives of one or more species relative to a defined baseline condition. Second, functional or trophic diversity can change if a member of a trophic guild is removed or if the comparative abundance of the guild member greatly increases or decreases. This can change the way biomass is distributed within the trophic guild and can affect the functional contribution of the trophic guild to the total ecosystem. Third, the selective removal of organisms that share a particular characteristic, e.g., rapid growth, can alter genetic diversity within a species. Removal of spawning aggregations also has the potential to alter genetic diversity if the particular aggregation of fish removed from the system is genetically different from other aggregations. In general, the evolutionary advantage of a species increases with genetic diversity, because the population is better prepared to respond to variations in natural conditions such as temperature, salinity, and water quality changes.

Historical baseline information on fish species diversity in the BSAI and GOA ecosystems is incomplete, and little survey and systematic information has been gathered on other ecosystem components such as the benthic fauna. Although no fishing-related species removals have been documented in these ecosystems during the past 30 years, species with slow growth characteristics or low reproductive potential, such as skates, sharks, and grenadiers, are considered to be at risk, particularly in light of evidence indicating that extinctions or near-extinctions of similar Atlantic species have occurred (Greenstreet and Rogers 2000). Bycatch from commercial fisheries has removed individuals belonging to these sensitive species for many years, and there will continue to be a potential for their gradual depletion, although the new retention and utilization requirements, noted above, will alleviate this trend. Because comparatively little is known about the taxonomic structure of benthic communities of the BSAI and GOA, the direct and indirect effects of trawling and other fishing-related activities on the species diversity of these communities have not been quantified. Finally, climate changes and regime shifts have had the potential to alter species diversity in the past and will continue to exert this influence over the long term as existing resident species are replaced by those better adapted to changing conditions.

During the period of Russian exploration and settlement of the BSAI region, two indigenous species, the Steller sea cow (*Hydrodamalis gigas*), a species of manatee or dugong, and the spectacled cormorant (*Phalacrocorax perspicillatus*) both became extinct—the sea cow by 1768 and the cormorant by 1850. In both cases, direct mortality from hunting is believed to have been the cause (ADF&G 2000e). The continuing decline in the Steller sea lion population has raised renewed concerns about the possibility of further extinctions. In addition to this and other species listed under the ESA as endangered or threatened, some Alaskan salmon stocks are showing a declining trend that has been speculated to have resulted from over-fishing. Consequently, salmon stocks are treated as separate species under the ESA (P. Livingston, NMFS Alaska Fisheries Science Center, personal communication).

In the GOA, the presence of Atlantic salmon has been recorded in waters off southeast Alaska (McKinnell et al. 1997), and recent studies in Prince William Sound have documented introductions of non-indigenous species there (Hines et al. 2000). There have been 24 non-indigenous species of plants and animals documented primarily in shallow marine and estuarine environments in Alaska, with 15 such species recorded for Prince William Sound. Predators such as the Amur starfish (*Asterias amurensis*), a Siberian species, have the potential to create major disruptions to benthic communities, but adverse effects of exotic species have yet to be reported for Alaskan waters. Nevertheless, it is a fact that the species diversity of the BSAI and GOA ecosystems has been lastingly, and probably permanently, altered by the introduction of non-indigenous species.

There is no documented indication that the functional, or trophic, diversity of the BSAI and GOA ecosystems has been affected by commercial fisheries, although climatic trends and regime shifts, thought to be the major forcing agents driving these ecosystems, could produce this type of effect. Changes in the relative abundance of species within trophic guilds in the BSAI and GOA have been attributed to natural background fluctuations in recruitment. These changes, however, have been within the historical limits of natural fluctuations and would presumably occur in the complete absence of fishing and other human activities. Livingston et al. (1999) investigated the variability and evenness of biomass levels in guilds of the eastern Bering Sea. These workers found no evidence that groundfish fisheries had caused declines in trophic guild diversity for the groups studied. Changes in guild biomass diversity were observed when a dominant guild component (e.g., pollock) changed in abundance, but these changes were related primarily to recruitment rather than to fishing. There appeared to be no significant loss of functional (trophic) diversity. This evidence, while minimal, suggests that future changes in functional diversity are not likely to result from human activities in the BSAI and GOA regions if the pattern of such activities remains similar to present conditions.

Genetic diversity within species, the third type of biodiversity indicator, may have received past influences from American and foreign commercial fisheries. For example, concern about the depletion of pollock stocks in the Donut Hole region of the Central Bering Sea led to an international moratorium on fishing in the region in 1993 and to the 1994 Convention on the Conservation of the Pollock Resources in the Central Bering Sea. The genetic diversity of the BSAI and GOA ecosystems has not been systematically studied, and this data gap prevents establishment of a reliable baseline against which future assessments might be gauged to determine if significant changes have occurred. If a fishery concentrates on certain spawning aggregations or on older (larger) age classes of a target species that tend to have greater genetic diversity (dating from an earlier period when fishing was less intensive), then genetic diversity will tend to decline in fished versus unfished systems. As discussed in Section 4.9, it is possible that genetic diversity has already declined in the BSAI and GOA ecosystems as a result of commercial fishing, but this cannot be known in the absence of a baseline. Even in historically heavily fished systems such as the North Sea, there is little evidence that, for example, selection for body length in cod has reduced genetic diversity after 40 years of intensive fishing (Jennings and Kaiser 1998). Genetic assessments of North Pacific pollock populations and subpopulations conducted by Bailey et al. (1999) have indicated that there are genetic variations among different stocks, but these studies have not found genetic variability across time within the same stocks that might indicate past or current effects from commercial fishing or other external influences. In general, there is little evidence to suggest that genetic diversity is affected by external factors acting on the BSAI and GOA ecosystems.

Potential cumulative effects associated with the five alternatives are summarized in Table 4.13.9-3. Alternative 1, No Action, has the potential to produce conditionally significant adverse direct and/or indirect effects on species diversity, as discussed in Section 4.9 and indicated in Table 4.9-3. Additive or synergistic effects from past, current, and future fisheries and commercial shipping could increase the severity of the negative impact potentially associated with this alternative, resulting in a conditionally significant adverse cumulative effect. These external influences could include species depletions from targeted catch and bycatch, mechanical disturbance of benthic habitats by bottom trawling, introductions of non-indigenous species that could out-compete and displace native species, and climatic trends or regime shifts that prove unfavorable for some species. On the other hand, favorable climate and regime shifts could completely neutralize these adverse effects, because these natural events are the primary forces driving the BSAI and GOA ecosystems. Accordingly, the conditionally significant cumulative effect on species diversity associated with Alternative 1 could be either adverse or positive (+/-).

With respect to functional (trophic) diversity, Alternative 1 could contribute marginally to a cumulative effect in association with the major ecosystem drivers, climatic trends and regime shifts, if these conditions altered the relative abundance of species within trophic guilds. The external control exerted by climate and regime conditions could either increase or decrease functional diversity. The cumulative component of this effect,

however, would not be significant, because it would not differ measurably from the effect of the external factors by themselves.

Similarly, Alternative 1 could produce a cumulative effect on genetic diversity within the BSAI and GOA ecosystems, in combination with adverse effects from commercial fisheries and with either positive or adverse effects of climate and regime. As noted above, it has been speculated that spatial concentration by foreign fishing fleets on walleye pollock in the Donut Hole region of the Central Bering Sea may have contributed to the depletion of the local pollock population in the vicinity of Bogoslof Island, leading to an international moratorium on fishing in the Donut Hole since 1993 and to the 1994 Convention on the Conservation of the Pollock Resources in the central Bering Sea (Pautzke 1997). In general, however, there is little evidence to suggest that genetic diversity has been affected by cumulative influences acting on the BSAI and GOA, and it is concluded that this cumulative effect, if any, would not be significant.

Alternatives 2 through 5 are similar, in that they have all been concluded to have a conditionally significant positive direct or indirect effect on species diversity and no significant direct or indirect effects on functional and genetic diversity. With respect to species diversity, the potentially positive influence of any of these alternatives could be offset by adverse effects from IPHC, foreign, domestic, and/or JV fisheries through over-fishing, bycatch mortality, and benthic damage from bottom trawling, and by the tendency of commercial shipping to introduce exotic species through ballast water discharges and the release of hull-fouling invertebrates. Climatic and regime changes, however, could overshadow all such effects, driving species diversity in either direction. Therefore, Alternatives 2 through 5 are concluded to have the potential to produce a conditionally significant cumulative effect that could be either positive or adverse (+/-).

With respect to functional (trophic) diversity, Alternatives 2 through 5 have all been evaluated as having no significant direct or indirect effect by themselves. In combination with climate and/or regime shifts, any of these alternatives could provide a marginal cumulative contribution, but it would not be significant, i.e., measurable against the background influence of the ecosystem drivers.

In the case of genetic diversity, Alternatives 2 through 5 have been concluded to exert a conditionally significant positive effect. Because these alternatives would affect commercial fishery management policy, they could outweigh the existing adverse effects of selective removals of fish and marine invertebrates with optimal market characteristics by these fisheries. Again, however, the major ecosystem drivers—climatic change and regime shifts—would exert the controlling influence. The resulting cumulative effect could be conditionally significant, and either positive or adverse, depending on the relative levels of contribution by all of these factors.

Table 4.13-40 Cumulative Effects Summary – Biological Diversity

Past Effects

Direct/Indirect Effects		External Effects					Past Influence Y/N
Category	Human Controlled				Natural Events		
	IPHC Fishery	Foreign Fisheries	JV & Domestic Fisheries	Commercial Shipping	Climate & Regime Shifts		
Species diversity		-	-	-	-	+/-	Y
Functional (trophic) diversity		0	0	0	0	+/-	Y
Genetic diversity		-	-	-	0	+/-	Y

Alternative 1

Direct/Indirect Effects	
Category	Rating
Species diversity	CS(-)
Functional (trophic) diversity	NS
Genetic diversity	NS

External Effects		
Human Controlled		Natural Events
IPHC, Foreign, Domestic & JV Fisheries	Commercial Shipping	Climate & Regime Shifts
-	-	+/-
0	0	+/-
-	0	+/-

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	Y(+/-)
Y	N
Y	N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-40 Cumulative Effects Summary – Biological Diversity (Continued)

Alternatives 2 through 5

Direct/Indirect Effects	
Category	Rating
Species diversity	CS(+)
Functional (trophic) diversity	NS
Genetic diversity	CS(+)

External Effects		
Human Controlled		Natural Events
IPHC, Foreign, Domestic & JV Fisheries	Commercial Shipping	Climate & Regime Shifts
-	-	+/-
0	0	+/-
-	0	+/-

Cumulative Effect Y/N	Conditionally Significant Y/N
Y	Y(+/-)
Y	N
Y	Y(+/-)

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.10 State-managed Fisheries

The state-managed fisheries for invertebrates (crab, sea urchin, sea cucumber, scallops), herring, salmon, rockfish, sablefish, and lingcod are not affected by the alternatives being considered for this action. Different alternatives would have differing effects on the state managed Pacific cod fisheries in the GOA (Parallel Pacific Cod Fisheries), the Prince William Sound (PWS) pollock fishery (Parallel Pollock Fisheries), and the BSAI Atka mackerel fisheries (Parallel Atka Mackerel Fisheries). The predicted direct and indirect effects for each alternative on these fisheries are described in Section 4.10.

For the purposes of determining a cumulative effect on a given target fish resource such as pollock or Pacific cod, on a prohibited species such as herring or salmon, or on a fishing sector or region/community, the occurrence of these state-managed fisheries is considered under the category of external impacts. The impacts are presented for the resource, not for the fishery itself. It can be inferred that if a resource is impacted, the resultant fishery is also impacted. Therefore, the reader is referenced to the target, non-specified, forage, and prohibited species sections (Sections 4.13.2, 4.13.3, 4.13.4, and 4.13.5), for discussions related to cumulative effects on the resources associated with state-managed fisheries. The cumulative socioeconomic impacts of the alternatives as related to these fisheries are considered in Section 4.13.12.

With regard to the state-managed Pacific cod fishery, a state managed-Pacific cod fishery was first implemented in 1997 in state waters in the Gulf of Alaska (ADF&G 2000d). State harvest levels are set as a percentage of the federal acceptable biological catch (ABC). The state's Guideline Harvest Levels for the Pacific cod fisheries are set at a level of up to 25% of the federal ABC for the GOA. As a result there is a limit to available TAC in the state fishery and to the ability of vessels to transfer from federal to state Pacific cod fisheries. Currently, the Pacific cod fishery in state near shore waters is not subject to either the current court-ordered closure of Steller sea lion critical habitat, or the closures identified in Alternatives 2 through 5. This fishery may present an opportunity to mitigate the economic effects of Alternatives 2 through 5 on small, community based vessels that fish in near shore waters, particularly in the Alaska Peninsula and Kodiak regions. The Biological Opinion (Appendix A) finds that the state waters season for pollock in PWS and the Pacific cod in the GOA as they are currently managed do not jeopardize or adversely modify the critical habitat of the endangered western population of Steller sea lions. However, the federal action considered in the Biological Opinion assumed that management measures designed to protect Steller sea lions in the federal groundfish fisheries would also be adopted by the State of Alaska for the parallel fisheries which occur concurrently in state waters.

Alternatives which contain management measures differing from those in effect in 1998 that further restrict Pacific cod, pollock, and Atka mackerel fishing and by the lowering of TAC, by expanding area closures around rookeries and haulouts, or by imposing catch limits within Steller sea lion critical habitat in the EEZ would also effect harvest levels in the parallel Pacific cod and pollock fisheries in state waters during the fishing year. However, there would be no reasonably foreseeable external actions resulting in cumulative effects on the fisheries themselves.

4.13.11 Management and Enforcement

Depending on the alternative, more complex patterns of areas closed to transit or fishing, daily catch limits and other additional quotas, and seasonal restrictions would require increases in staff and budget for management and enforcement. Alternatives 2 through 5 would result in significant adverse direct and indirect effects. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. However, these external management and enforcement requirements would not effect one alternative more than another. As a result, combined with the direct and indirect effects,

cumulative management and enforcement effects would be significant and adverse. For more detail, refer to the cumulative socioeconomic impacts of the alternatives presented in Section 4.13.12.

4.13.12 Socioeconomic Cumulative Effects

Steller sea lion protection alternatives potentially affect a variety of socioeconomic characteristics of the human environment. The evaluation of cumulative socioeconomic effects is presented in four sections, beginning with a summary of affected environment factors relevant to the cumulative effects analysis, followed by a discussions of external factors and cumulative effects on the fishing industry sectors/consumer values and the regions and communities.

4.13.12.1 Summary of Affected Environment Factors

The fishing industry sectors, consumer values, and regions and communities addressed in the cumulative effects analysis are summarized below:

Fishing Industry Sectors and Consumer Values

1. *Catcher Vessels* - four categories of trawl vessels (203 vessels in 1998), pot vessels (72 vessels in 1998), long-line vessels (102 vessels in 1998), and two categories of fixed-gear vessels (807 vessels in 1998)
2. *Catcher Processor Vessels* - Surimi trawl (12 vessels in 1999), fillet trawl (4 vessels in 1999), head and gut trawl (24 vessels in 1999), long-line (40 vessels in 1999), and pot vessels (9 vessels in 1999)
3. *Inshore Processors* - Bering Sea pollock inshore (6 processors in 1999), Alaska Peninsula and Aleutian Islands inshore (10 processors in 1999), Kodiak Island inshore (9 processors in 1999)
4. *Motherships* - a relatively large vessel that does not normally fish itself, but rather acts as a mobile processor, accepting fish or crab from a fleet of catcher vessels (3 processors in 1999)
5. *Net Benefits to Consumers* - The Bering Sea and Aleutian Islands and the Gulf of Alaska groundfish fisheries provide high and relatively stable levels of seafood products to domestic and foreign markets.
6. *Non-consumptive and non-use values* - Studies have shown significant willingness on the part of the general public to pay for the existence of species (and the preservation of endangered species) as well as the preservation of wilderness areas which the individuals never expect to see.

For more information consumer values and fishing industry sectors, refer to Section 2.5 of this SEIS.

Regions and Communities

Alaska Peninsula and Aleutian Islands

Socioeconomic Characteristics - The Alaska Peninsula and Aleutian Islands region is, in many ways, the center of the Alaska groundfish fishery. During 1991–1999, this region accounted for more than four times the volume of groundfish processed inshore than in the other Alaska regions combined. Four of Alaska's top five groundfish landing ports are in this region, but some other communities have little if any direct involvement with the fishery.

Within the Alaska Peninsula and Aleutian Islands region, the growth of the domestic groundfish fishery has caused profound changes in the communities of Unalaska and Akutan. In Unalaska, in recent years it has provided the mainstay of the fisheries based portion of the economy and generally reversed the local economic decline that followed the crash of the King crab fishery. Unalaska has historically been the number one fishing port in the nation for value and volume of catch landed. Both inshore and offshore sectors have contributed to the local tax base and the economic climate that has fostered the development of a significant support services sector.

Three other communities in the Alaska Peninsula and Aleutian Islands region that are substantially involved with the groundfish fishery and are the sites of large processing facilities are Akutan, King Cove, and Sand Point. In Akutan, the groundfish fishery, primarily in the form of a large groundfish oriented shore plant, has transformed the community from a small primarily Native community to a much larger community predominately non-Native community. Implications of this change should be interpreted with caution, as the processor and the rest of the community remain separate in a number of different ways. Lesser changes have been seen in King Cove and Sand Point, although both have experienced significant growth in local groundfish processing in recent years. Sand Point's residential catcher vessel fleet has benefitted disproportionately from the development of the groundfish fishery in comparison to other communities in the region. However, the current Area M chum salmon cap and low salmon prices could affect both communities if they continue on a long term basis.

Employment and Income - Alaska Peninsula and Aleutian Islands communities have a wide range of employment opportunities and income levels; these opportunities are closely related to the commercial fishery in general, and the groundfish fishery in particular. Processing workers tend to be in the community because of the employment opportunity, tend to leave when employment terminates, and comprise a significant portion of the population. In 1997, almost five times as many persons were employed in manufacturing than in the next most important sector, state and local government. Regional personal income and earnings from manufacturing exceeded earnings of all other sectors combined in 1997.

Fiscal Characteristics - The relatively new fishery resource landing tax is a source of revenue that comes from the offshore sectors of the fishery. It is designed to capture some of the economic benefits of offshore activity for adjacent coastal Alaska regions, and is far more important to the revenue structure, in both absolute and relative terms, to the Alaska Peninsula and Aleutian region than for any other region.

Akutan, King Cove, Sand Point, and Unalaska all have local raw fish taxes, and the first three also levy a borough raw fish landing tax. Fisheries related taxes accounted for 99.7 percent of all the shared taxes and fees coming to the region from the state in 1999, and total fisheries-related tax revenues exceeded \$7 million. The offshore processing component paid more than \$2 million in Fisheries Resource Landing tax in 1999.

Importance of Other Fisheries - As stated above, the commercial fishery is directly or indirectly (through support services) the primary source of employment in the Alaska Peninsula and Aleutian Islands region. Groundfish account for approximately 48% of the round weight tons of processed fish in the region; crab is also important however, comprising approximately 41% of the processed fish in round weight tons. Salmon accounts for about 8% of this total (Appendix C).

The current trends in other state and federal fisheries are discussed in detail in section 4.13.12.2 Fishing Industry Sectors and Consumer Values. In brief, however, the commercial salmon fisheries particularly in the Alaska Peninsula and Aleutian Islands region are subject to limitations, harvest caps and predicted low 2001 run forecasts (as compared to the recent 5-year average, ADF&G 2001b) which combine to indicate a downward trend in the fishery. Cumulatively, this means both that harvesters and processors targeting groundfish would be unable to redirect effort into the salmon fishery to make up any shortfall. Processing plants may already be reacting to decreasing revenues from salmon, which would increase the potential

impact of any change in groundfish availability. For regions and communities, this impact translates into the potential for a decrease in employment and income, for those employed in both the harvesting and processing sectors.

Trends in the commercial and state crab fisheries carry particular weight in the Alaska Peninsula and Aleutian Islands region, due to the high percentage of total processing in the region dedicated to crab. The crab fisheries have generally been in decline as stock size has decreased and remained depressed; the fisheries have increasingly been closed off to commercial fishing, or become subject to strict quotas. Catch for the Bristol Bay red and Aleutian Islands golden king crab fisheries was 20% less in 2000 than in 1999. The cumulative impact of the trends in the crab fisheries on regions and communities is similar to that of the salmon fisheries, but in direct proportion to the dependence of a particular community on crab in relation to groundfish. A community which is involved in both sectors and which is already undergoing the impacts of a decline in the crab fisheries will be less able to negotiate the adverse impacts of restrictions on the groundfish fisheries.

The other fishery which may also impact on this cumulative effects analysis is the state managed Pacific cod fishery. This fishery is generally limited to small vessels, and is not currently subject to the restrictions on fishing in Steller sea lion critical habitat which are applicable in the federal fishery. The redirection of effort into the state-managed fishery could offset adverse impacts at the region and community level of restrictions resulting from Steller sea lion protection measures. Should such redirection cause a reasonable likelihood of a significant negative impact to Steller sea lions, ADF&G has indicated that it would pursue measures to impose similar critical habitat restrictions on the state fishery. This would minimize any potential for beneficial cumulative impact, and could impact adversely those communities involved in the state-managed fishery.

Other Economic Development Activities - Although there are various other potential economic development activities which take place in the Alaska Peninsula and Aleutian Islands region, in general these have minimal cumulative effect due to their relative insignificance in relation to the importance of commercial fishing-related activities. The potential activities are however discussed below.

Oil and gas exploration associated with Cook Inlet, Gulf of Alaska, and Bering Sea leases has historically been staged out of some coastal fishing communities. There is a small possibility that additional exploration could occur associated with pending lease sales over the next 10 years. These activities would generate short-term employment, service demands, and local tax revenue in relatively localized areas, but are not likely to make any significant long-term contributions to regional economies.

Military clean-up and construction projects have historically generated employment and economic activity of local significance in the Alaska Peninsula and Aleutian Islands and Kodiak regions. These activities are likely to continue at specific locations such as Amchitka, and could be supplemented by missile defense system projects in Shemya. These activities would generate short-term employment, service demands, and generate local tax revenues in relatively localized areas, but are not likely to make any significant long-term contributions to regional economies.

Tourism has been increasing in Alaska in general, and in coastal Alaskan communities that depend on fishing. These activities are of a larger scale in southeast and Southcentral Alaska, where road access and/or cruise ship port calls generate a significant amount of seasonal economic activity. Tourism is increasing in the Kodiak Island and Aleutian Island and Alaska Peninsula regions, but their remote location, high travel costs, and limited infrastructure will keep levels and economic contributions modest.

Transportation infrastructure projects (port, airport, road) have traditionally generated short-term employment and service demands associated with their construction, and often facilitated long-term economic activity through improved transportation access and reduced costs. They will continue to influence local economies

in specific areas, particularly the Aleutian Islands, Alaska Peninsula, Kodiak and southeast Alaska regions, although funding is dependent on state and federal sources. However, marine infrastructure development in the Aleutian Islands and Alaska Peninsula, may be adversely affected by the designation of critical habitat for Steller's eider.

Other Revenue Sources - Revenue from taxes and service charges is a significant source of funding for municipal and state capital improvement services and capital projects in many Alaskan communities. In many of the communities that participate in commercial fish harvesting and processing, state and local taxes on fish landings and fisheries-related property have generated varying degrees of revenue.

Other state and federal fisheries, particularly salmon, crab, and halibut, have generated substantial revenues for the state and specific local communities throughout Alaska. The current status of the commercial crab fisheries and localized problems in commercial salmon fisheries have resulted in significant reductions in municipal revenue for specific communities, particularly in the Alaska Peninsula/ Aleutian Island and Kodiak regions.

Other sources of revenue considered in the cumulative effects analysis are shared state revenue programs including Power Cost Equalization, municipal revenue sharing, and general state funding for education and capital projects. Funding for all these programs has been reduced significantly over the last five years, increasing the need for municipal contributions to maintain essential services and facilities.

Kodiak Island Region

Socioeconomic Characteristics - Within the Kodiak Island region, the City of Kodiak has been the prime beneficiary of the development of the groundfish fishery. The fishery served as an important buffer after changes in other fisheries, for example, after the decline of the locally important shrimp and crab fisheries, as well as the Bering Sea crab fisheries. Other GOA fishing activities important for this region include salmon and halibut.

Employment and Income - The economies of Kodiak Island region communities are all heavily dependent on fishing, and for the City of Kodiak, groundfish are an important component of this dependence. In terms of aggregated statistical economic sector measures, fishing and fish processing activities rank first for this region. This sector provides an important base for the retail, service, and government sectors, which follow it in relative size. The military sector is also significant, primarily because of a local Coast Guard base.

Fiscal Characteristics - The City of Kodiak and the Kodiak Island Borough are the primary taxing entities in the region. The Kodiak Island Borough levies a property tax of 9.25 mills, a 5 percent accommodations tax, and a 0.925 percent severance tax on natural resources. Other communities levy limited taxes. Under the status quo, fisheries related taxes accounted for 94.7 percent of all the shared taxes and fees coming to the region from the state in 1999, The region's share of the fisheries business tax and fishery resource landing tax amounted to \$1,330,586 in 1999.

Importance of Other Fisheries - As stated above, the commercial fishery is directly or indirectly (through support services) a primary source of employment in the Kodiak region. Groundfish account for approximately 46% of the round weight tons of processed fish in the region; in this region the secondary product is salmon, at 39% of total processing volume. Crab comprises only 3% of the total (Appendix C).

The declining trend in the commercial salmon fishery is the primary adverse cumulative impact for the Kodiak region, due to the importance of that product to the region. Although crab comprises a significantly lower percentage of total processing product in the Kodiak region, its decline nonetheless has some cumulative effect on the overall health of the Kodiak harvesting and processing sectors, given the primary

dependence of many local community economies on the commercial fishery sector. In a similar way, the state-managed Pacific cod fishery around Kodiak may also receive a significant increase in effort as a result of redirection of effort from the federally-managed fishery. While potentially beneficial in the short-term, an increase in fishing activity could result in significantly adverse impacts for Steller sea lions and, in bringing about State-imposed restrictions on the fishery, adversely impact to those currently involved in it.

Other Economic Development Activities - As with the Alaska Peninsula and Aleutian Islands region, while other economic development activities do take place within the region, their regional and community impact tends to be overshadowed by the economic dependency on commercial fishing, with the exception of a few localized communities. As with the region described above, military clean-up and construction projects and transportation infrastructure both present limited opportunities for employment, but are likely to provide a long-term contribution to regional economies. Tourism is increasingly a source of employment and income in the Kodiak region, but is likely to remain modest due to the remoteness of the location and the consequent high cost of travel and transportation.

Other Revenue Sources - The similarity between the Alaska Peninsula and Aleutian Islands, and Kodiak regions in terms of their dependence on commercial fisheries, applies to source of municipal revenue. A significant amount of revenue for the communities comes from fisheries-related taxes, including not only groundfish but other fisheries in proportion to their effort in the region. Although transfer taxes from at-sea processors are only a fraction in Kodiak of their importance in the Alaska Peninsula and Aleutian Islands region, nonetheless they are a contributing factor.

Kodiak has also been affected by the significant reduction over the last five years in shared state revenue programs and general state funding which has left an increasing need for municipal contributions to maintain essential services and facilities.

Southcentral Alaska Region

Socioeconomic Characteristics - The Alaska southcentral region has not seen the level of fishing related changes experienced by communities in the Alaska Peninsula and Aleutian Islands or Kodiak Island Region regions, in part, because 98 percent of groundfish processed in Alaska is processed in regions other than Alaska southcentral region.

Employment and Income - The economies of Alaska southcentral region groundfish communities tend to be more diversified than those of Alaska Peninsula and Aleutian Islands or Kodiak Island Region. In part, this is a function of being connected by roads and associated access to a large population base, as well as the presence of other developable resources. In comparison with the manufacturing sector, in 1997, 8 sectors had a greater employment and 10 sectors had greater income (the service sector alone had 10 times the number of jobs and 8 times the income of manufacturing).

Fiscal Characteristics - Municipal revenues derived from commercial groundfish are very small compared to other sources of revenue. At \$1,521,569 in fiscal year 1999, 73.3 percent of the region's taxes and fees shared with the State were fisheries-related.

Southeast Alaska Region

Socioeconomic Characteristics - Much like Alaska southcentral region, the southeast Alaska region has not seen the level of changes as was experienced in regions with a less diversified economy. The groundfish fishery is a significant economic component for certain communities within the region, however the most important targeted species are rockfish and sablefish. Three ports, Petersburg, Sitka, and Yakutat, account

for almost all of the region's reported processing. All three communities support diverse fisheries, with salmon and halibut the most important.

Employment and Income - Fisheries in general, and groundfish fisheries in particular, are relatively small contributors to the southeast Alaska region employment base, especially compared to the government, services, and retail sectors. For the three communities of most concern, fishing and fish processing are more important in absolute terms than in the average regional community. Still, the groundfish fishery does not provide a large base for regional employment.

Fiscal Characteristics - Revenues directly resulting from local landings or processing of groundfish provide a minimal contribution to municipal revenue in southeast Alaska region. Only Yakutat has a local fish tax, and it applies to salmon rather than to fish in general. Shared state fisheries taxes do generate revenue for local communities, and southeast Alaska region's 1999 share of the fisheries business tax and fishery resource landing tax amounted to \$2,221,926, which was 88 percent of such shared revenue for the region.

Washington Inland Waters Region

Socioeconomic Characteristics - The Washington Inland Waters region as a whole, and the greater Seattle area in particular, is engaged in all aspects of the North Pacific groundfish fishery. While this region is distant from the harvest areas, it is the organizational center of much of the industrial activity that comprises the human components of the fishery. Seattle is arguably more involved in the Alaska groundfish fishery compared to all other communities, whether counted in terms of current residence, community of origin, or community of original hire. Paradoxically, it could be argued that the fishery is less important or vital for Seattle than for the other communities considered because the total number of Alaska groundfish-fishery-related jobs in Seattle compared to the overall number of jobs in Seattle is small, in contrast with the same type of comparison for the smaller Alaska coastal communities.

Employment and Income - The fishing industry has a significant presence in parts of the region, but is greatly overshadowed in terms of employment by other more highly developed and extensive economic sectors, such as retail trade and services which are the two largest in terms of employment.

Oregon Coast Region

Socioeconomic Characteristics - Oregon Coast region has had significant involvement in the Alaska groundfish fishery, from the development of the joint venture foreign fishery to the present domestic fishery. It is relatively diversified and relies heavily on the retail, service, and government sectors. Fish and timber are also significant components of the multi-industry economy.

Western Alaska Commercial Development Quota Groups

Six western Alaska CDQ groups representing 65 villages have been formed, based on participation from Alaska Native Claims Settlement Act villages in proximity to the Bering Sea. CDQ's have been allocated portions of the BSAI groundfish fishery, ranging from 10 percent of pollock harvest, to 7.5 percent for most other species. CDQ's have provided up to 1,000 jobs annually for western Alaska residents, with annual wages of about \$5-8 million, and have used revenues to fund vessel acquisition (primarily vessels larger than 58 feet) and seafood-related businesses, and to fund infrastructure improvements in western Alaska communities. Pollock has accounted for 25 percent of the jobs and 32 percent of the wages. CDQ groups also have quota shares of other fisheries, including crab and halibut.

For more information on communities and regions, refer to Section 3.12 and Appendix F of this SEIS.

Past Internal and External Socioeconomic Trends

The fish harvesting and processing industry participating in the groundfish fishery has undergone extensive change over the last decade. These include the transition from foreign to domestic fisheries, and numerous fisheries management plan (FMP) amendments addressing allocation of catch, bycatch limitations, gear and vessel restrictions, groundfish yield, and protection of marine mammals. During this period, changes have also occurred in other federal and state commercial fisheries such as salmon, halibut, and crab, which affect vessels and processors that participate in both those fisheries and the groundfish fisheries.

A brief summary of past effects on the fishing industry sectors is presented below. For more information on present direct and indirect effects, refer to section 4.12.1 of this SEIS and in the Regulatory Impact Review (Appendix C). In addition, detailed information on historical trends in the harvesting and processing sectors can be found in Appendix I of the Groundfish Draft Programmatic SEIS:

Trends in Consumer Benefits and Non-consumptive Values

1. *Consumer Benefits* - During this period, the development of a domestic groundfish fishery and increases levels of catch have had a beneficial effect on consumers by providing a stable supply of fish products. U.S. consumption of fish products has increased, becoming more commonly used in "fast foods", packaged meals, and in institutional markets. Domestic production is not adequate to meet domestic demand, which is supplemented by foreign sources of processed white fish.
1. *Existence, Non-market, and Non-consumptive Values* - The continuing decline of the western Steller sea lion population and classification under the Endangered Species Act has heightened concern for the species and existence values. This decline has also resulted in less animals available for subsistence harvest, although corresponding decreases in subsistence harvest levels may be attributable to other causes. During the same period, eco-tourism related activities have increased, particularly in Southcentral Alaska where Steller sea lions are an attraction. The level and nature of fishing effort associated with the domestic groundfish fishery has resulted in concerns regarding adverse effects on existence and non-market/non-consumptive values associated with the Bering Sea and Gulf of Alaska.

Trends in Groundfish Industry Sector Participation and Harvest levels

- *Catcher Vessels* - Between 1991 and 1998, the overall number of catcher vessels decreased roughly 25 percent.
 - *Catcher Processors* - Between 1991 and 1998, the overall number of catcher processors decreased roughly 20 percent; declines occurred in all catcher processor classes.
 - *Inshore Processors and Motherships* - Between 1991 and 1998, the overall number of inshore processors and motherships decreased roughly 15 percent, with the exception of a slight increase in Alaska Peninsula and Aleutian Islands inshore plants, and Bering Sea pollock inshore plants, which have remained stable.
 - *Exvessel Value and Tonnage* - Between 1991 and 1998, the total exvessel value of groundfish has fluctuated while the exvessel value of non-groundfish has generally decreased; the total tonnage of groundfish has decreased roughly 22 percent; the proportion of the Atka mackerel, rockfish, sablefish, other groundfish species group in total groundfish catch has increased slightly while the proportion of pollock has decreased slightly; and the proportion of BSAI and GOA contribution to total groundfish harvest has remained roughly the same (a ratio of 9 to 1).
1. *Operating Costs* - Variable and fixed operating costs such as fuel, insurance and labor have all increased. As indicated in Appendix C, fuel costs in have nearly doubled in some regions over the last two years. Where excess harvesting and processing capacity exists, particularly for vessels and plants rely on other fisheries such as crab and salmon that have seen reductions in available harvest quotas, the ratio of fixed costs to revenue generated has become less favorable.
 2. *Safety impacts* - Allocation of TAC to various harvesting and processing sectors has reduced the "race for fish" to some degree, improving the safety of vessel operation. The catcher vessel fleet operating out of Alaskan communities is generally smaller in size than catcher processor vessels, and is limited in how far offshore they can safely operate. As a result, they tend to focus effort in nearshore waters where concentrations of fish exist but include areas identified as Steller sea lion critical habitat.
 3. *Excess capacity* - As discussed above, there has been a decrease in catcher vessels, catcher processors, and inshore processors participating in groundfish fisheries. However, this has been offset by increases in harvesting and processing efficiency, excess capacity from declines in other federal and state fisheries, and market share loss to other sources of wild and farmed fish.
 4. *Prohibited fish catch and discards* - As fishermen have gained experience with fishing specific areas and specific gear types, and management amendments have been implemented, bycatch of prohibited species and other species has decreased. The ratio of fish harvested used in product has increased over the last decade. Both trends have had reduced the level of bycatch.

Trends in Economic Development and Municipal Revenue

Regional participation in the groundfish fisheries has created opportunities for regional ownership of vessels and onshore processors, regional employment and associated increases in population, and generated tax revenue for local and state government. More indirectly, the fisheries have created a demand for community infrastructure and services, have influenced land use and transportation services, and have affected subsistence and recreation activities to a certain degree. A general summary of past and present effects on the affected regions is presented below:

- *Regional Economies* - The economies of the Alaska Peninsula and Aleutian Islands and Kodiak Island regions are heavily dependent on fishing and groundfish; the economies of the other Alaskan, Washington, and Oregon regions are more diversified, and fishing provides a significantly smaller contribution to these regions. Within these other regions, harvesting and processing jobs in the groundfish fishery may be of greater importance to specific communities within those regions. Because of the reliance of Alaska Peninsula and Aleutian Islands and Kodiak Island regions on commercial fishing, these regions are sensitive to changes in other commercial fisheries such as crab and salmon.
 - *Processing Employment and Income* - Between 1991 and 1998, processing employment and income has varied depending on the region, and what other fish/shellfish are processed:
 - for the Alaska Peninsula and Aleutian Islands region, processing employment has increased by roughly 33 percent, although payments to labor have decreased by 12 percent
 - for the Kodiak region, processing employment has increased 25 percent, and payments to labor have increased roughly 10 percent
 - for the southcentral and southeast Alaska regions, both processing employment and payments to labor have fluctuated, with no long-term trends evident
 - for the Washington region, processing employment has fluctuated (with 1999 being a unusually low year); payments to labor have decreased roughly 50 percent from 1991; there is no Oregon resident participation in processing
 - *Catcher Vessels Ownership* - The number of catcher vessels owned by Alaska Peninsula and Aleutian Islands and Kodiak regional residents has increased or remained stable since 1991; ownership has decreased over 25 percent during this period for the southcentral Alaska region, decreased 40 percent for the southeast Alaska region, decreased 10 percent for Washington Inland Waters region, and remained stable for the Oregon Coast region.
5. *Other Economic Development activities* - The regional economies of Southcentral Alaska, Washington Inland Waters, and the Oregon Coast regions are relatively diverse and are not overly reliant on fisheries. Within the Aleutian Islands/Alaska Peninsula and Kodiak Island regions, fishing is the dominant economic activity. Other economic activities that have historically influenced these regional economies are military bases and site cleanup and municipal construction projects. With the closure of Adak Naval Air Station, near completion of Adak and Amchitka site clean-up, and reductions in municipal revenue from fish tax, other economic activities have had less of an impact on local economies.
- *Municipal and State Revenues* - Taxes on groundfish landed and processed have become a significant source of shared revenue to local municipalities and the State of Alaska, and have contributed to municipal revenue amounts ranging from \$1.3 million in the Alaska Kodiak region to over \$7 million in the Alaska Peninsula and Aleutian Islands. Several municipalities also have fuel transfer taxes where vessels participating in the groundfish fishery generate local revenue. Furthermore, real and personal property tax on both onshore processing facilities and fishing vessels generate additional revenues for specific municipalities. Revenues directly resulting from local landings or processing of groundfish are not the primary basis for local taxation in the southcentral and southeast Alaskan regions, although both received shared fish tax revenue from the state.
 - *Human Population Levels* - Community and regional population levels are linked to employment opportunities and "economic health;" the greater the dependence on a particular economic sector like fishing, the more likely that population changes would respond to changes in employment opportunities. The Alaska Peninsula and Aleutian Islands regional economy is the most dependent on commercial fishing, followed by Alaska Kodiak region. While it is difficult to attribute historic

trends in population to changes in the groundfish fisheries, these regions have significant male populations typically associated with seafood processing workforces that can comprise a significant percentage of the population. It would stand to reason that a significant long-term reduction in the available jobs would result in a reduction in population if replacement jobs were not available. The linkage between fisheries employment and population in Alaska southcentral, Alaska southeast, Washington Inland Waterways and Oregon Coast (with the exception of a few specific communities) is not as pronounced.

For further information on historic fishing industry trends and baseline characteristics, refer to Section 3.10.2 of the Groundfish Draft Programmatic SEIS (NMFS 2001a). For further information on community and regional trends, refer to Section 3.10.3 of the Groundfish Draft Programmatic SEIS.

4.13.12.2 Summary of External Factors and Effects

External Factors Considered in Evaluating Cumulative Effects on Consumer Values and the Fishing Industry

External factors for evaluating cumulative socioeconomic effects are those activities that have synergistic or interactive effects on the primary socioeconomic characteristics of the region and its communities. This cumulative analysis assesses various categories of impact.

1. Effects of other commercial fishing activities on Steller sea lions and other intrinsic environmental values of the Bering Sea and Gulf of Alaska.
1. Effects of other fisheries (foreign, federal, and state) on existence, non-market, and non-consumptive values
1. Effects of costs and revenues associated with participation in other commercial fisheries on overall annual operating costs and revenue of groundfish harvesting and processing classes that participate in other fisheries besides groundfish.
- Effects of excess capacity of vessel and processing classes resulting from opportunities or exclusion from other commercial fisheries.
- Effects of targeted catch or bycatch of prohibited species in other fisheries.
- Effects on safety issues associated with the race for fish resulting from opportunities associated with other commercial fisheries.
- Effects on excess harvesting and processing capacity associated with opportunities associated with other commercial fisheries.

1. Availability to consumers of seafood products from other Alaska and foreign fisheries.

The specific external factors addressed in this analysis are discussed below.

Foreign Fisheries

Historically, foreign fisheries have had a significant cumulative influence on groundfish stocks:

- Foreign vessel were the first to exploit specific fish stocks and develop commercial fisheries and markets for the products; in the course of doing so, many fisheries were over-harvested, with long-

term effects on stocks and the sustainable yield of specific fisheries. Foreign vessels also began using Alaska ports for services, which led to the expansion or development of commercial services and marine infrastructure in many coastal communities

- Development of joint venture fisheries led to the development of domestic fish harvesting and processing capacity, through foreign and domestic investment in harvesting and processing infrastructure
- Current patterns of ownership and product markets on fisheries harvesting and processing. Foreign ownership in inshore fish processing is significant, and has influenced the form of the fish product, specific processing lines and equipment, and transport and distribution of processed product.

Foreign fisheries currently provide groundfish for many of the same domestic and foreign markets supplied by Alaska groundfish and compete for market share. Of particular importance are Russian stocks of pollock, and Chinese reprocessing of Russian and Alaskan-caught pollock. If harvest levels of Alaska groundfish are reduced under specific alternative sea lion protection measures, foreign fisheries could capture market share currently being served by Alaskan product. Fish from foreign aquaculture operations could also capture market share from Alaskan groundfish under similar circumstances. These include hake and hoki. If market share is lost to farmed fish, it may be difficult to recover at a future date.

Because they fish for species that are prey for Steller sea lions, foreign fisheries have a potential to effect existence and non-consumptive values associated with Steller sea lions. However, information on sea lion foraging patterns, and distribution of both stocks fished by foreign fleets and areas of harvest is inadequate to assess the potential level of effect.

Other federal and state fisheries

Catcher vessels and inshore processors participating in the groundfish fishery also participate in other federal and state fisheries. Trends and harvest levels in these fisheries may offset or exacerbate the effects from Steller sea lion protection alternatives, in both the harvesting and processing sector. The fisheries that have the greatest potential for cumulative effects are federal crab (Tanner and king), salmon and halibut fisheries, and state groundfish fisheries (Pacific cod and pollock); herring and scallop fisheries are a minor factor. Several classes of catcher vessels and inshore processors currently participate to a certain degree in these fisheries in addition to their groundfish fishery activity, and rely on the combined harvest for economic feasibility.

Entry of additional vessels into the salmon and halibut fisheries is currently limited by permit; participation in the crab fisheries is limited by vessel size, gear requirements, and license to participate in the fishery. This limits the potential for vessels either to increase their effort in those fisheries or for others not currently permitted to enter the fishery. In several communities, the processing sector handles a range of product (groundfish, crab and salmon); in other communities they are more specialized, focusing on one or two products. Where groundfish is a primary or secondary product line, a significant decrease in groundfish availability could jeopardize the economic viability of processing other fish and the ability to remain operating in a specific community. Given projected closures and reductions in commercial crab fisheries, recent trends in salmon prices, and the likely continuation (or further reductions) of the Area M chum salmon cap, some participants in these fisheries will experience adverse cumulative effects. Conversely, changes in state groundfish quotas could have beneficial or adverse effects on vessels and processors, depending on the alternative.

These other fisheries also affect consumer values and non-consumptive values. The availability of other Alaska seafood products such as salmon, crab and halibut provides net benefits to domestic seafood

consumers. However, the extent and intensity of these other fisheries can adversely affect non-consumptive and non-use values by potentially competing with Steller sea lions for prey and contributing to the perceived level of fishing in the Bering Sea and Gulf of Alaska (GOA).

State Commercial Salmon Fisheries - Statewide, the 1999 commercial salmon fishery resulted in the second largest number of salmon commercially harvested in Alaska's history. However, the fiscal year 2000 salmon season resulted in a declaration of economic disaster for western Alaska; parts of Bristol Bay, the Gulf of Alaska, and Cook Inlet also had poor returns. The Statewide number and weight of fish harvested in 2000 was the second lowest in the past 5 years (ADF&G 2001b). While salmon harvests are cyclical in many areas, the Alaska Department of Fish and Game (ADF&G) considers the commercial fishery stocks in most of the areas of the state to be healthy; three recent trends are worth noting. First, the salmon runs in the Yukon and Kuskokwim River drainages have regularly been low over the last several years, creating economic hardship for participants in those commercial and subsistence fisheries. Second, limitations on chum salmon catch by Area M Aleutians Islands community fisherman in an effort to limit interception of Yukon-Kuskokwim bound salmon have also economically impacted participants in that commercial salmon fishery. It is assumed for the purpose of this analysis that both trends will continue in the short-term, resulting in lower income for harvesters and processors in those two fisheries. Finally, the worldwide supply of farmed salmon originating outside of Alaska and competition from other foreign fisheries will continue to increase supply and depress salmon prices.

Cumulative effects implications for the groundfish fishery are:

1. As a limited entry fishery, there is essentially no opportunity for harvest sector transfer from groundfish to salmon if vessels are not currently in the fishery, without buying an existing permit.
2. Processing sector participants could potentially try to process more salmon in response to groundfish fishery management alternatives that result in less groundfish harvest available, but would have to compete with existing processors. The implications of status of salmon stock in the Yukon-Kuskokwim River systems and the chum salmon intercept caps would further limit the opportunities for Aleutian Island and Alaska Peninsula based catcher vessels and shore based processors to make up for lower groundfish harvest levels by processing salmon. The combination of lower groundfish harvest levels with the low prices and depressed availability of salmon in certain areas would create economic problems for harvesters and processors that depend on both of these fisheries.

State and Federal Commercial Crab Fisheries - The Alaskan crab fisheries take place in both state and federal waters west of the 144 degree West longitude, within the central and western GOA, around the Aleutian Islands and the eastern Bering Seas. Seven species of crab have supported commercial fisheries over the last three decades. However, many of these crab fisheries peaked in the early 1980s or mid-1990s and have since been closed.

Harvest of red king crabs took place in several areas but has been subject to seasonal and long-term geographic closures. Stock size has generally declined and has remained depressed; the only areas currently open to commercial fishing include Bristol Bay and a portion of Norton Sound. Blue king crab has gone through a similar history of exploitation and decline; fisheries are currently only conducted in the vicinity of Saint Matthew and the Pribilof Islands. Golden king crab was historically harvested but is currently a sporadic fishery. Tanner crab have historically been harvested in several locations, but the *bairdi* fishery has been closed in most locations since the mid-1990s. No commercial Tanner crab fisheries were open in the Bering Sea in 2000. Snow crab has been commercially harvested in the Bering Sea; 229 vessels participated in the fishery in 1998, which was one of the best harvest years in a decade. However, the Bering sea *opilio* catch in 2000 was slightly more than one tenth of the 1998 catch. Korean hair crab has historically been harvested in the Pribilof District of the Bering Sea, but has declined since 1995. Dungeness crab was also widely

harvested on a commercial basis but harvest has declined over time. Part of the Kodiak district and the Alaska Peninsula remains open seasonally but harvests are sporadic.

Cumulative effects implications for the groundfish fishery are:

1. There is virtually no unutilized capacity in crab fisheries available to new entrants into the fishery; in fact the number of vessels participating in most of the fisheries has been decreasing. Certain catcher vessels (AFA with crab endorsement and pot) participate in both groundfish and crab fisheries. The *bairdi* fishery remains closed. The projected quota for the Bristol Bay red king crab fishery is 20 percent less than last year, and the *opilio* snow crab fishery has been declared overfished; any openings next year will be dependent on the result of NMFS trawl surveys.
2. Processing sector participants could potentially try to process more crab in response to groundfish fishery management alternatives that result in less groundfish harvest available, but would have to compete with existing processors and work within designated crab allocation caps. The combination of lower groundfish harvest levels with the depressed availability of crab in certain areas would create economic problems for both harvesters and processors that depend on both fisheries.

Commercial Halibut Fisheries - Halibut stocks are considered relatively healthy by the International Pacific Halibut Commission (IPHC). The commercial fishery is a type of limited entry fishery with individual fishing quotas (IFQ), and occurs in both the Bering Sea and Aleutian Islands and Gulf of Alaska. IFQ's have been allocated by relative size and type of vessel to maintain an equitable mix of harvesters in the fisheries. Additional parties may not enter the fishery without purchasing IFQ shares from an existing participant of similar fishery characteristics.

Cumulative effects implications for the groundfish fishery are:

1. The fishery and harvest levels are considered stable, and should have no contribution as cumulative effects to catcher vessels and processors that are already participating in the fishery.
2. Groundfish harvest and processor sector participants not already in the fishery could not enter the fishery to compensate for reduced availability of groundfish.

State Commercial Groundfish Fisheries - The State of Alaska manages certain commercial groundfish fisheries in state waters within the Bering Sea and Aleutian Island and Gulf of Alaska; the State also has management authority over certain rockfish species and lingcod throughout the EEZ. Species commercially harvested include Pacific cod, sablefish, lingcod, Walleye pollock, and two species of rockfish. Of these fisheries, the only species of significance to the cumulative effects analysis is Pacific cod, because these fish contribute significantly to the overall catch and have a potential for synergistic cumulative effects under certain alternatives.

A state managed-Pacific cod fishery was first implemented in 1997 in state waters in the Gulf of Alaska (ADF&G 2000d). Approximately 18 percent of the combined federal/state Pacific cod harvest comes from state waters. Fishing is limited to pot and jig gear and generally to vessels under 58 feet in length in most areas, and requires exclusive area registration. If state harvest levels are not met by late in the season, the fishery is opened to all gear types. State harvest levels are set as a percentage of the federal acceptable biological catch (ABC). As a result there is a limit to the ability of vessels to transfer from federal to state Pacific cod fisheries. Approximately 38 percent of the catch comes from the South Alaska Peninsula Management Area, followed by Kodiak and Chignik. Currently, the Pacific cod fishery in state near shore waters is not subject to either the current court-ordered closure of Steller sea lion critical habitat, or the closures identified in Alternatives 2 through 5.

Cumulative effects implications for the groundfish fishery are as follows:

1. The state Pacific cod fishery is not currently affected by the closures of critical habitat in federal fisheries, and is limited to relatively small vessels; it may present an opportunity to mitigate the economic effects of Alternatives 2 through 5 on small, community based vessels that fish in near shore waters, particularly in the Alaska Peninsula and Kodiak regions.
2. The potential for transfer of effort into the state fishery by current participants in the federal Pacific cod fishery could have effects on areas within State waters that are considered critical habitat for Steller sea lions. This could potential offset prey competition and disturbance mitigation provided by alternatives to the no action alternative. ADF&G has indicated that if fishery activities in State waters impact Steller sea lions, they will institute appropriate management measures.

Other Market Factors

Other factors could affect price and demand for groundfish, such as the rising U.S. dollar relative to currencies of countries with high levels of groundfish imports, and negative effects on exvessel values of all vessels and processors, or higher or lower global harvests of fish/seafood and fish inventories that could serve as substitutes for groundfish. These factors are difficult to predict and are not considered as a major factor in this analysis.

Environmental Factors

In addition to these human induced factors, the fishing industry sector has also been influenced by trends in the natural environment related to short-term and long-term cyclic patterns, which are discussed in Sections 3.1.9 and 3.9 of the Groundfish Draft Programmatic SEIS (NMFS 2001a). It is assumed that any effects of cyclic patterns on target fish stocks will be incorporated into current management measures, and are not discussed further in this section.

Tables 4.13-41 through 46 summarize the past effects and cumulative effects of Alternatives 1 through 5.

Other economic development activities

These may interfere with or compete for labor, services, and facilities; or provide additional employment and revenue opportunities for local communities. Direct and indirect employment opportunities associated with economic developments may offset or exacerbate the effects from Steller sea lion protection alternatives. In addition, employment opportunities directly affect the population of a community or region, and increase demand for municipal services and population based revenue sharing (such as education). The economic development activities that have the greatest potential for cumulative effects are oil and gas exploration/production (primarily potential exploration activities in Cook Inlet, and potentially out of Dutch Harbor), military projects (contaminated site clean-up and missile defense projects in the Alaska Peninsula and Aleutian Islands), tourism, and marine or air-related transportation projects. Oil and gas exploration activities are most likely to occur. However, economic development in coastal Alaskan communities, particularly in the Aleutian Islands and Alaska Peninsula, may be adversely affected by the designation of critical habitat for Steller's eider. This issue is already affecting construction of marine infrastructure projects and may affect other coastal activities.

Other sources of municipal and state revenue

Municipal and state revenue funds local facilities and services. Within Alaska, regions and communities participating in the fishing industry generate revenue and/or receive shared State revenue from taxes on

fishing (in some cases over 99 percent), and from non-fishing sources. The level of income differs among communities, depending on a variety of factors including whether municipal governments levy a raw fish tax on exvessel value landings, or tax fuel transfer or other fisheries related services. Changes in these revenue streams may offset or exacerbate the effects from Steller sea lion protection alternatives. Changes in revenue streams may affect the communities' ability to provide municipal services, fund capital projects, borrow money, and retire debt service. The assessment of whether other factors in addition to the change in groundfish fishery-generated revenue have a cumulative impact on regions and communities requires analysis of various external factors. The programs that have the greatest potential for cumulative effects are revenues from landing taxes on non-groundfish fisheries (such as salmon, crab, and halibut), power cost equalization, and municipal revenue sharing programs from the state of Alaska (including shared education funding). During recent years, state municipal revenue sharing, power cost equalization, and contribution to education programs have been decreasing.

Table 4.13-41 Fishing Industry Sector and Consumer Values – Alternative 1 No Action - Past Effects

Direct/Indirect Effects of Groundfish Fishery	External Effects					Past Effect Y/N
Category	Human Controlled					
	Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources	
Existence Benefits	-	-	-			Y-
Non-market subsistence use	-	-	-			Y-
Non-consumptive eco-tourism	na	na	na			na
Harvests & fish prices (Total ex-vessel value)	+	+	+			Y+
Product Quality & Revenue Impacts	+	+	+			Y+
Operating Cost Impacts	0	0	0			N
Safety Impacts	na	-	-			N
Impacts on Related Fisheries	-	-	-			N
Costs to Consumers	+	+	+			Y+
Management and Enforcement Costs	0	0	0			N
Excess capacity	na	-	-			Y-
Prohibited species bycatch and discards	-	-	-			N

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.12.3 Analysis and Significance of Cumulative Effects - Consumer Values and the Fishing Industry

Review of Direct and Indirect Effects

Direct and indirect impacts of the alternatives on fishing industry sectors and consumer values were evaluated in section 4.12.1 of this document and in the Regulatory Impact Review (Appendix C). Although many indicators were analyzed for the direct and indirect effects of the alternatives, for the purposes of a cumulative effects analysis, the following are prioritized for their utility in describing the sectoral and consumer values impacts:

1. *Existence values* -value placed by society on the existence and stability of Steller sea lion populations
2. *Non-market subsistence values* -value of Steller sea lions as a subsistence resource to Alaska Natives
3. *Non-consumptive eco-tourism use* - value of Steller sea lion as a wildlife resource for eco-tourism

4. *Harvests and fish prices* - projected harvest levels and fish prices, including uncertainty regarding the ability to harvest TAC in new areas outside critical habitat closed to fishing (harvest considered at risk)
5. *Operating cost impacts* - variable and fixed operating costs for harvesting and processing sectors, including costs associated with learning new fishing grounds
6. *Groundfish product values* - market value of various processed groundfish products
7. *Safety impacts* - effects on vessel operating safety due to "race for fish", vessel size/need to fish further offshore
8. *Impacts on related fisheries* - increases in non-target catch of cod and pollock, transfer of fishing effort to other target groundfish fisheries
9. *Costs to consumers* - potential market impacts from reductions in harvest of pollock, Pacific cod and Atka mackerel
10. *Management and enforcement costs* - costs associated with managing, monitoring and enforcing changes in areas open and closed to transit and harvest, based on critical habitat and gear type
11. *Excess capacity* - effects on harvesting and processing capacity due to changes in level and location of target groundfish harvests
12. *Prohibited fish catch and discards* - changes in levels of unintentional bycatch and discard volumes associated with changes in harvest areas and seasons

Cumulative Effects of Alternative 1 - No Action

Existence Benefits, Non-market Subsistence Use, and Non-consumptive Eco-tourism

By allowing current protection measures to expire, Alternative 1 would result in conditionally significant negative direct and indirect effects. These effects would be aggravated by continued prey competition resulting from fishing by foreign fleets, and fishing in state fisheries (primarily salmon, herring, and Pacific cod) that occurs in Steller sea lion critical habitat. These later activities could result in some competition for prey species and disturbance impacts. Because the jeopardy status of Steller sea lions is not alleviated, there is a possibility of establishing limits on subsistence harvests. Alternative 1 would result in significantly adverse cumulative effects.

Harvest and Fish Prices, Operating Cost Impacts, and Groundfish Product Values

Direct and indirect effects of Alternative 1 allow fishing under status quo conditions, and create conditionally significant positive effects. Given the current trends in the commercial salmon and crab fisheries, harvesting and processing sectors that rely on a mix of groundfish, salmon and crab will experience moderate adverse cumulative effects related to reductions total exvessel value and increases in average harvesting and processing costs in areas that are affected by other fishery closures or harvest limitations. These groups include shore-based Bering Sea pollock and Aleutian Island and Alaska Peninsula region processors; and certain trawl, pot, and fixed-gear catcher vessels, most of which are located in the Alaska Peninsula and Aleutian Island and Kodiak regions. Overall, the cumulative effects would be insignificant.

Safety Impacts

Because Alternative 1 would remove some fishing restrictions in areas identified as critical habitat for Steller sea lions, it would allow vessels to spend more time fishing in near shore waters, and reduce the potential for risk of accidents and injury (Appendix C). Alternative 1 would result in insignificant cumulative effects.

Consumer Impacts

Alternative 1 would maintain status quo for consumer supply, prices and product quality. Continued limited supply of crab due to depressed stocks and fishing closures would have an adverse cumulative impact on consumers. Overall, the cumulative effects would be insignificant.

Management and Enforcement Costs

Alternative 1 would maintain status quo for monitoring and enforcement. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. There would be insignificant cumulative effects on monitoring and enforcement.

Excess Capacity

Current groundfish capacity in vessels and processors would be maintained under Alternative 1. In addition, excess capacity in both catcher vessels and onshore processors would be significantly adversely affected by closures or limits on salmon and crab fisheries, again primarily in the Alaska Peninsula and Aleutian Island and Kodiak regions, including Bering Sea pollock shore plants. Cumulative effects would be significantly adverse, although of lesser magnitude than other alternatives.

Prohibited Species Catch and Discards

Alternative 1 would maintain current levels of bycatch of prohibited and other species. However, the significance of direct and indirect effects for all alternatives is unknown. The primary cumulative effects consideration would result from transfer of fishing effort from federal to state Pacific cod fisheries and discards and bycatch in foreign groundfish fisheries, which are both unknown. The significance of cumulative effects is unknown.

Cumulative Effects of Alternative 2 - Low and Slow Approach

Existence Benefits, Non-market Subsistence Use, and Non-consumptive Eco-tourism

Alternative 2 would create conditionally significant positive direct and indirect effects resulting from removing Steller sea lions from jeopardy status. It would potentially make more sea lions available for subsistence harvest and avoid the potential for limiting harvest levels due to jeopardy status. The conditionally significant positive direct and indirect effects created by Alternative 2 would be partially offset by continued prey competition resulting from fishing by foreign fleets, and fishing in state fisheries (primarily salmon, herring, and Pacific cod) that occurs in Steller sea lion critical habitat. These later activities could result in some competition for prey species and disturbance impacts. Based on offsetting effects, cumulative effects are expected to be insignificant.

Harvest and Fish Prices, Operating Cost Impacts, and Groundfish Product Values

Cumulative effects would vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. Under Alternative 2, direct and indirect effects for these categories would be significantly or conditionally significantly adverse. Because it involves a reduction in TAC, potential gross revenues are roughly 30% lower than the other alternatives. In addition, one third of the potential revenues are considered at risk. Currently, the out of state catcher and catcher/ processor vessels predominantly fishing the Alaska groundfish fishery would experience significant adverse direct and indirect effects associated with potential lower harvest levels, higher operating costs, and changes in product quality due to season shifts in fishing. Because these vessels exclusively target groundfish, there are few cumulative effects from trends in other federal and state fisheries. Market competition from foreign sources of pollock, farmed fish, and other substitutes could capture market share which would be difficult to regain. Any harvest level at risk associated with moving from critical habitat areas traditionally fished to new areas where the "learning curve" associated with fishing could result in conditionally significant adverse cumulative effects due to loss in market share and additional operating costs.

Catcher vessels and inshore processors would face similar problems with loss of market share, higher operating costs, and potential changes in product quality. In addition, the current adverse trends in the salmon and crab fisheries would exacerbate adverse effects related to lower harvest levels, operating costs, and product values for those vessels and processors that rely on these other fisheries to stay in business. Vessels most vulnerable to conditionally significant adverse cumulative effects would include trawl, pot, long-line, and fixed gear types that participate in crab and salmon fisheries. Inshore processors that rely on these same external fisheries would also experience conditionally significant adverse effects.

Safety Impacts

Because Alternative 2 would restrict fishing in areas identified as critical habitat for Steller sea lions, it would result in greater distances between ports and open fishing grounds and require fishing further offshore, with a high potential for increasing the risk of accidents and injury (Appendix C). Smaller catcher vessels based out of Alaska Peninsula/Aleutian Islands and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to more risk. Breaking fishing periods into seasons and setting daily catch limits, coupled with downturns in the crab and salmon fisheries, would increase the risk and result in conditionally significant adverse cumulative effects.

Consumer Impacts

Potential reduction in supply, loss in product quality, and higher prices would result in conditionally significant adverse effects on consumers. Foreign sources of groundfish product could offset effects on consumers to a certain extent, as could the supply of farmed fish and salmon. Continued limited supply of crab due to depressed stocks and fishing closures would have an adverse cumulative impact on consumers. Overall, the cumulative effects would be conditionally significant adverse, primarily due to the reduced TAC and the amount of harvest considered to be at risk.

Management and Enforcement Costs

Due to more complex closed areas, daily catch limits and other additional quotas, and seasonal restrictions, the required increase in staff and budget would result in significant adverse direct and indirect effects. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. There would be significant adverse cumulative effects on monitoring and enforcement.

Excess Capacity

Given the combination of seasonal distribution of fishing effort, daily catch limits, further distance to open fishing areas and catch reductions/catch at risk for some sector participants, there would be significant adverse direct and indirect effects on catcher vessel, catcher processor, and inshore processor excess capacity. Coupled with current trends in the commercial salmon and crab fisheries, catcher vessels that also rely on those fisheries would experience conditionally significant adverse cumulative effects on excess capacity. These effects would be most severe in the Alaska Peninsula, Aleutian Islands, and Kodiak Island. In the processing sector, onshore processors that rely on pollock and Pacific cod utilize a mix of groundfish, salmon, and crab. Up to 50 percent of their product value is derived from crab; salmon (NMFS 2001a). They would experience significant adverse cumulative effects on excess capacity under Alternative 2.

Prohibited Species Catch and Discards

As indicated in Appendix C, relocating fishing effort to new areas is likely to increase bycatch of prohibited and other species. However, the significance of direct and indirect effects for all alternatives is unknown. The primary cumulative effects consideration would result from transfer of fishing effort from federal to state Pacific cod fisheries and discards and bycatch in foreign groundfish fisheries, which are both unknown. The significance of cumulative effects is unknown.

Cumulative Effects of Alternative 3 - Restricted and Closed Area Approach

Existence Benefits, Non-market Subsistence use, and Non-consumptive Eco-tourism

Similar to Alternative 2, Alternative 3 would create conditionally significant positive direct and indirect effects resulting from removing Steller sea lions from jeopardy status. The conditionally significant positive direct and indirect effects created by Alternative 3 would be partially offset by continued prey competition resulting from fishing by foreign fleets, and fishing in state fisheries (primarily salmon, herring, and Pacific cod) that occurs in Steller sea lion critical habitat. These later activities could result in some competition for prey species and disturbance impacts. Based on offsetting effects, cumulative effects are expected to be insignificant.

Harvest and Fish Prices, Operating Cost Impacts, and Groundfish Product Values

Cumulative effects would vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. Under Alternative 3, potential gross revenues given TAC's are similar to Alternatives 1, 4, and 5; however roughly 25% of that revenue is considered at risk. Effects would be similar to, but of lesser magnitude than, Alternative 2. Catcher processors and inshore processors would face competition and loss of market share from foreign fisheries and farmed fish. Catcher vessels and inshore processors would be effected by adverse trends in salmon and crab fisheries, particularly in the Alaska Peninsula, Aleutian Islands, and Kodiak Island Borough. Cumulative effects would be conditionally significantly adverse.

Safety Impacts

Similar to Alternative 2, Alternative 3 would restrict fishing in areas identified as critical habitat for Steller sea lions. It would result in greater distances between ports and open fishing grounds and require fishing further offshore, with a high potential for increasing the risk of accidents and injury (Appendix C). Smaller catcher vessels based out of Alaska Peninsula/ Aleutian Islands and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to more risk. Coupled with downturns in the crab and salmon fisheries, Alternative 3 would increase the risk and result in conditionally significant adverse cumulative effects.

Consumer Impacts

Similar to Alternative 2, potential reduction in groundfish supply, loss in product quality, and higher prices would all result in conditionally significant adverse effects on consumers. Foreign sources of groundfish product could offset effects on consumers to a certain extent, as could the supply of farmed fish and salmon. Continued limited supply of crab due to depressed stocks and fishing closures would have an adverse cumulative impact on consumers. Overall, the cumulative effects would be conditionally significant adverse, primarily due to the amount of harvest considered at risk.

Management and Enforcement Costs

As with Alternative 2, more complex closed areas and seasonal restrictions would require increases in staff and budget, and would result in significant adverse direct and indirect effects. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. There would be significant adverse cumulative effects on monitoring and enforcement under Alternative 3.

Excess Capacity

As with Alternative 2, the combination of seasonal distribution of fishing effort, further distance to open fishing areas and catch at risk for some sector participants would result in significant adverse direct and indirect effects on catcher vessel, catcher processor, and inshore processor excess capacity. Coupled with current trends in the commercial salmon and crab fisheries, catcher vessels and inshore processors that also rely on those fisheries would experience conditionally significant adverse cumulative effects on excess capacity. These effects would be most severe in the Alaska Peninsula, Aleutian Islands, and Kodiak Island under Alternative 3.

Prohibited Species Catch and Discards

As indicated in Appendix C, relocating fishing effort to new areas is likely to increase bycatch of prohibited and other species. However, the significance of direct and indirect effects for all alternatives is unknown. The primary cumulative effects consideration would result from transfer of fishing effort from federal to state Pacific cod fisheries and discards and bycatch in foreign groundfish fisheries, which are both unknown. The significance of cumulative effects is unknown.

Cumulative Effects of Alternative 4 - Area and Fishery Specific Approach

Existence Benefits, Non-market Subsistence Use, and Non-consumptive Eco-tourism

Similar to Alternative 2, Alternative 4 would create conditionally significant positive direct and indirect effects resulting from removing Steller sea lions from jeopardy status. These positive effects would be partially offset by continued prey competition resulting from fishing by foreign fleets, and fishing in state fisheries (primarily salmon, herring, and Pacific cod) that occurs in Steller sea lion critical habitat. State fisheries could result in some competition for prey species and disturbance impacts. Because options A, B, and C allow a limited number of smaller vessels to fish in Critical Habitat, cumulative effects would be slightly greater under each of the options. Based on offsetting effects, cumulative effects are expected to be insignificant.

Harvest and Fish Prices, Operating Cost Impacts, and Groundfish Product Values

Cumulative effects would vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. Under Alternative 4, potential gross revenues given TAC's are similar to Alternatives 1, 3, and 5; roughly 5% of that revenue is considered at risk. Direct and indirect effects on harvest and price would be insignificant; effects on operating cost and groundfish product value would be significantly/conditionally significantly adverse but of lesser magnitude than Alternatives 2 and 3. These effects would primarily result from additional area closures, longer distance to fishing areas, and seasonal effects on product quality.

Catcher processors and inshore processors would face competition and loss of market share from foreign fisheries and farmed fish if product price increases and quality decreases. Operating costs for catcher vessels and product values for inshore processors would be exacerbated by adverse trends in salmon and crab fisheries, particularly in the Alaska Peninsula, Aleutian Islands, and Kodiak Island Borough. Cumulative effects would be insignificant.

Safety Impacts

Similar to Alternatives 2 and 3, Alternative 4 would restrict fishing in areas identified as critical habitat for Steller sea lions. It would result in the greater distances between ports and open fishing grounds and require fishing further offshore, with a potential for increasing the risk of accidents and injury (Appendix C). Smaller catcher vessels based out of Alaska Peninsula/ Aleutian Islands and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to more risk. Coupled with downturns in the crab and salmon fisheries, Alternative 4 would increase the risk and result in conditionally significant adverse cumulative effects, although to a lesser degree than Alternatives 2 and 3. Options A, B, and C would result in improvements in operating safety for those smaller, Alaskan community-based vessels allowed to fish closer to shore.

Consumer Impacts

Similar to Alternatives 2 and 3, there would be some potential loss in product quality, and higher prices due to higher operating costs. However, direct and indirect effects on consumers would be insignificant. Foreign sources of groundfish product could offset effects on consumers to a certain extent, as could the supply of farmed fish and salmon. Continued limited supply of crab due to depressed stocks and fishing closures would have an adverse cumulative impact on consumers. Overall, the cumulative effects would be insignificant, primarily due to the limited amount of harvest considered at risk.

Management and Enforcement Costs

As with Alternative 2 and 3, more complex closed areas and seasonal restrictions would require increases in staff and budget, and would result in significant adverse direct and indirect effects. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. There would be significant adverse cumulative effects on monitoring and enforcement.

Excess Capacity

As with Alternatives 2 and 3, the combination of seasonal distribution of fishing effort and further distance to open fishing in some areas would result in significant adverse direct and indirect effects on catcher vessel, catcher processor, and inshore processor excess capacity. However, the magnitude of these effects would be less than Alternatives 2 and 3. Coupled with current trends in the commercial salmon and crab fisheries,

catcher vessels and inshore processors that also rely on those fisheries would experience conditionally significant adverse cumulative effects on excess capacity. These effects would be most severe in the Alaska Peninsula, Aleutian Islands, and Kodiak Island. Options A, B, and C would partially mitigate excess capacity if these options resulted in vessels staying in the groundfish fishery.

Prohibited Species Catch and Discards

As indicated in Appendix C, relocating fishing effort to new areas is likely to increase bycatch of prohibited and other species. However, the significance of direct and indirect effects for all alternatives is unknown. The primary cumulative effects consideration would result from transfer of fishing effort from federal to state Pacific cod fisheries and discards and bycatch in foreign groundfish fisheries, which are both unknown. The significance of cumulative effects is unknown.

Cumulative Effects of Alternative 5 - Critical Habitat Catch Limit Approach

Existence Benefits, Non-market Subsistence Use, and Non-consumptive Eco-tourism

Similar to Alternatives 2, 3, and 4, Alternative 5 would create conditionally significant positive direct and indirect effects resulting from removing Steller sea lions from jeopardy status. These positive effects would be partially offset by continued prey competition resulting from fishing by foreign fleets, and fishing in state fisheries (primarily salmon, herring, and Pacific cod) that occurs in Steller sea lion critical habitat. State fisheries could result in some competition for prey species and disturbance impacts. Based on offsetting effects, cumulative effects are expected to be insignificant.

Harvest and Fish Prices, Operating Cost Impacts, and Groundfish Product Values

Cumulative effects would vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. Under Alternative 5, potential gross revenues given TAC's are very similar to Alternative 4; roughly 10% of that revenue is considered at risk. As a result, direct and indirect effects on harvest and price, operating cost and groundfish product value would be significantly/conditionally significantly adverse but of lesser magnitude than Alternatives 2 and 3. These effects would primarily result from additional area closures, longer distance to fishing areas, and seasonal effects on product quality.

As with other alternatives, catcher processors and inshore processors would face competition and loss of market share from foreign fisheries and farmed fish if product price increases and quality decreases. Operating costs for catcher vessels and product values for inshore processors would be exacerbated by adverse trends in salmon and crab fisheries, particularly in the Alaska Peninsula, Aleutian Islands, and Kodiak Island Borough. Cumulative effects would be conditionally significantly adverse.

Safety Impacts

Similar to Alternatives 2, 3, and 4, Alternative 5 would restrict fishing in areas identified as critical habitat for Steller sea lions. It would result in the greater distances between ports and open fishing grounds and require fishing further offshore, with a potential for increasing the risk of accidents and injury (Appendix C). Smaller catcher vessels based out of Alaska Peninsula/ Aleutian Islands and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to more risk. Coupled with downturns in the crab and salmon fisheries, Alternative 5 would increase the risk and result in conditionally significant adverse cumulative effects, although to a lesser degree than Alternatives 2 and 3.

Consumer Impacts

Similar to Alternatives 2, 3, and 4, there would be some potential loss in product quality, and higher prices due to higher operating costs. However, direct and indirect effects on consumers would be insignificant. Foreign sources of groundfish product could offset effects on consumers to a certain extent, as could the supply of farmed fish and salmon. Continued limited supply of crab due to depressed stocks and fishing closures would have an adverse cumulative impact on consumers. Overall, the cumulative effects would be insignificant, primarily due to the limited amount of harvest considered at risk.

Management and Enforcement Costs

As with Alternatives 2, 3, and 4, more complex closed areas and seasonal restrictions would require increases in staff and budget, and would result in significant adverse direct and indirect effects. Major considerations for cumulative effects include continued monitoring and enforcement of foreign fishing effort, and the potential transfer of fishing effort from federal to state Pacific cod fisheries in the Gulf of Alaska and the Aleutian Islands. There would be significant adverse cumulative effects on monitoring and enforcement.

Excess Capacity

As with Alternatives 2, 3, and 4, the combination of seasonal distribution of fishing effort and further distance to open fishing areas would result in significant adverse direct and indirect effects on catcher vessel, catcher processor, and inshore processor excess capacity. However, the magnitude of these effects would be less than Alternatives 2 and 3. Coupled with current trends in the commercial salmon and crab fisheries, catcher vessels and inshore processors that also rely on those fisheries would experience conditionally significant adverse cumulative effects on excess capacity. These effects would be most severe in the Alaska Peninsula, Aleutian Islands, and Kodiak Island.

Prohibited Species Catch and Discards

As indicated in Appendix C, relocating fishing effort to new areas is likely to increase bycatch of prohibited and other species. However, the significance of direct and indirect effects for all alternatives is unknown. The primary cumulative effects consideration would result from transfer of fishing effort from federal to state Pacific cod fisheries and discards and bycatch in foreign groundfish fisheries, which are both unknown. The significance of cumulative effects is unknown.

Table 4.13-42 Fishing Industry Sector and Consumer Values – Cumulative Effects for Alternative 1

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Existence Benefits	CS-	-	0	-			Y	Y-
Non-market subsistence use	CS-	-	0	-			Y	U
Non-consumptive eco-tourism	CS-	-	0	-			Y	Y-
Harvests & fish prices (Total ex-vessel value)	CS+	-	-/+	-/+			Y	N
Operating Cost Impacts	CS+	NA	-/+	-/+			Y	N
Groundfish product values	CS+	-	NA	+			Y	Y+
Safety Impacts	CS-	NA	0	-/+			Y	N
Impacts on Related Fisheries	U	-	U	U			Y	U
Costs to Consumers	CS+	+	-/+	-/+			Y	Y+
Management and Enforcement Costs	I	-	0	0/-			Y	N
Excess capacity	CS-	NA	-	-			Y	Y-
Prohibited species bycatch and discards	I	-	-	-			Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-43 Fishing Industry Sector and Consumer Values – Cumulative Effects for Alternative 2

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Existence Benefits	CS+	-	0	-			Y	N
Non-market subsistence use	CS+	-	0	-			Y	N
Non-consumptive eco-tourism	CS+	-	0	-			Y	N
Harvests & fish prices (Total ex-vessel value)	S-	-	-/+	-/+			Y	Y-
Product Quality & Revenue Impacts	CS+	NA	-/+	-/+			Y	Y-
Operating Cost Impacts	S-	-	NA	+			Y	Y-
Safety Impacts	CS-	NA	0	-/+			Y	Y-
Impacts on Related Fisheries	U	-	U	U			U	U
Costs to Consumers	CS-	+	-/+	-/+			Y	Y-
Management and Enforcement Costs	S-	-	0	0/-			Y	Y-
Excess capacity	S-	NA	-	-			Y	Y-
Prohibited species bycatch and discards	U	-	-	-			U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-44 Fishing Industry Sector and Consumer Values – Cumulative Effects for Alternative 3

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Existence Benefits	CS+	-	0	-			Y	N
Non-market subsistence use	CS+	-	0	-			Y	N
Non-consumptive eco-tourism	CS+	-	0	-			Y	N
Harvests & fish prices (Total ex-vessel value)	S-	-	-/+	-/+			Y	Y-
Product Quality & Revenue Impacts	CS-	NA	-/+	-/+			Y	Y-
Operating Cost Impacts	S-	-	NA	+			Y	Y-
Safety Impacts	CS-	NA	0	-/+			Y	Y-
Impacts on Related Fisheries	U	-	U	U			U	U
Costs to Consumers	CS-	+	-/+	-/+			Y	Y-
Management and Enforcement Costs	S-	-	0	0/-			Y	Y-
Excess capacity	S-	NA	-	-			Y	Y-
Prohibited species bycatch and discards	U	-	-	-			U	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-45 Fishing Industry Sector and Consumer Values – Cumulative Effects for Alternative 4

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Existence Benefits	CS+	-	0	-			Y	N
Non-market subsistence use	CS+	-	0	-			Y	N
Non-consumptive eco-tourism	CS+	-	0	-			Y	N
Harvests & fish prices (Total ex-vessel value)	NS	-	-/+	-/+			Y	N
Product Quality & Revenue Impacts	CS-	NA	-/+	-/+			Y	N
Operating Cost Impacts	S-	-	NA	+			Y	Y-
Safety Impacts	CS-	NA	0	-/+			Y	N
Impacts on Related Fisheries	U	-	U	U			Y	U
Costs to Consumers	NS	+	-/+	-/+			Y	N
Management and Enforcement Costs	S-	-	0	0/-			Y	N
Excess capacity	NS	NA	-	-			Y	Y-
Prohibited species bycatch and discards	U	-	-	-			Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-46 Fishing Industry Sector and Consumer Values – Cumulative Effects for Alternative 5

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Existence Benefits	CS+	-	0	-			Y	N
Non-market subsistence use	CS+	-	0	-			Y	N
Non-consumptive eco-tourism	CS+	-	0	-			Y	N
Harvests & fish prices (Total ex-vessel value)	CS-	-	-/+	-/+			Y	Y-
Product Quality & Revenue Impacts	CS-	NA	-/+	-/+			Y	N
Operating Cost Impacts	CS-	-	NA	+			Y	Y-
Safety Impacts	CS-	NA	0	-/+			Y	N
Impacts on Related Fisheries	U	-	U	U			Y	U
Costs to Consumers	NS	+	-/+	-/+			Y	N
Management and Enforcement Costs	S-	-	0	0/-			Y	N
Excess capacity	CS-	NA	-	-			Y	Y-
Prohibited species bycatch and discards	U	-	-	-			Y	U

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.13.12.4 Analysis and Significance of Cumulative Effects - Regions and Communities

Review of Direct and Indirect Effects

Direct and indirect impacts of the alternatives on regions and communities were evaluated in section 4.12.2 in the SEIS. Although many indicators were analyzed for the direct and indirect effects of the alternatives, the following were prioritized for their utility in describing regional and community impacts:

- *Total regionally owned catcher vessel harvest volume* - an indication of direct participation by regional residents in the harvest sector.
- *Total ex-vessel value paid by shorebased processors in the region* - an indication of the relative value of the relevant groundfish species coming ashore in the region, and provides a good indicator of the level and changes in level of the local fisheries related tax base.
- *Total shorebased processing volume in the region* - an indication of the level of activity taking place on shore in the region.
- *Total harvesting and processing payments to labor accruing to the region* - an indication of the value of the fishery employment to the residents of the region.
- *Total harvesting and processing employment accruing to the region* - an indication of changes in the total groundfish fisheries employment in the region.

Cumulative Effects of Alternative 1 - No Action

A summary of cumulative effects for Alternative 1 is provided in Table 4.13.13.-7. In areas with large communities and more diversified economies and revenue sources, cumulative effects under Alternative 1 are not likely to be significant. This includes southcentral Alaska, Washington, and Oregon.

The southcentral Alaska region is unlikely to experience cumulative impacts from any change in the fisheries for pollock, Pacific cod or Atka mackerel, as the fishery represents only a small portion of its varied economic whole. As such, this region is not considered further in the cumulative effects analysis. The southeastern Alaska region as a whole is also unlikely to be affected cumulatively by changes to the groundfish fishery due to its diversity of employment base and municipal revenue. Although three southeastern Alaska communities within the region may experience a higher degree of impact from the changes in the groundfish fishery, they are not highly dependent on the pollock, Pacific cod and Atka mackerel fisheries concerned in this analysis, and not be considered further in this analysis. Similar to the southcentral Alaska region in terms of diversity of economic dependency, except on a larger scale, the Washington Inland Waters region is not considered further in this cumulative effects analysis. Although the direct and indirect socioeconomic effects of the Alaska groundfish fishery are important to this region, the sector is dwarfed by economic diversification. The Oregon Coast region is also considered only in terms of direct and indirect impacts of the Steller sea lion protection alternatives. The region is not dependent either on the pollock, Pacific cod or Atka mackerel fisheries, nor on commercial fishing in general, and so cumulative effects are unlikely to be significant.

Direct and indirect effects on the other Alaskan communities and regions within that depend on the groundfish industry are significantly beneficial under Alternative 1. However, specific regions and communities within Alaska are likely to see adverse cumulative effects primarily due to current trends in other fisheries (salmon, crab) and revenue sharing (reduction in general state revenue sharing and reductions in fish tax from salmon) continue, particularly in the Alaska Peninsula and Aleutian Island and Kodiak

regions where the economy is not diverse and relies on commercial fishing. Significant cumulative adverse effects would include declines in employment, economic activity, and state and municipal revenue. Other potential economic activities in those areas are not likely to offset these adverse effects to a significant degree.

Cumulative Effects of Alternative 2 - Low and Slow Approach

Significant adverse cumulative effects of Alternative 2 would result from the conjunction of significant direct and indirect declines in groundfish-based employment and income, fishing industry expenditures, and state and municipal revenues, with concurrent declines in other commercial fisheries and revenue sources (Table 4.13.13-8).

In conjunction with significant adverse direct and direct effects, employment and income levels in communities with strong harvest and processing participation in commercial crab fisheries, and to a lesser extent in the commercial salmon fishery, would significantly decline. Onshore processors in the Alaska Peninsula and Aleutian Islands and Kodiak regions would see short to long term reductions in workforce in conjunction with closures in the opilio crab fisheries, reductions in red king crab quota, harvest caps on chum salmon and low salmon prices. Catcher vessel classes participating in these fisheries would see similar reductions. Potential public infrastructure and military construction projects would not substantially mitigate the significant adverse effects.

In other regions, there would be some cumulative adverse effects with reductions in employment and income in other catcher vessel classes, catcher processors and other onshore processors, but given the diversity of the economies in those areas and the relatively small contribution of groundfish generated employment, cumulative effects would not be significant.

Reductions in direct labor and income from commercial fisheries, and local expenditures in those fisheries would have a cumulative adverse effect on secondary employment and economic activity. While no accurate estimates of employment multipliers exist, they are estimated to be between one to two times direct employment. Reductions in fishery projects and local expenditures would have adverse cumulative effects on transportation and other services associated with the fishing industry.

Reductions in pollock, Pacific cod and Atka mackerel harvests projected in Alternative 2 would have significant adverse direct and indirect effects on municipal raw fish and property taxes and the shared state fisheries taxes on exvessel value and processed transfers. The Alaska Peninsula and Aleutian Islands region and the Dutch Harbor community in particular depend heavily on such revenue, and when combined with reductions in revenues from commercial crab and salmon fisheries, the cumulative impacts would potentially be severe. Adverse effects also could have indirect adverse effects such as reductions in municipal bond ratings. All regions and communities with a lack of economic diversification and a reliance on commercial fishing would be significantly impacted. Other municipalities and regions in Alaska that participate in the groundfish fishery would be adversely affected, but reliance on other fisheries besides crab and the relative health of salmon stocks would minimize cumulative effects.

Cumulative Effects of Alternative 3 - Restricted and Closed Area Approach

Cumulative effects for Alternative 3 would be significantly adverse with the combination of declines in the groundfish fishery and other fisheries (Table 4.13.13-8). The large differential between low and high estimates in the potential gross revenues of Alternative 3 creates a difficulty in assessing with confidence the degree of impact, however should the revenue outcome be anything other than at the high end of the estimate spectrum, the cumulative impacts would be severe.

Alternative 3 was compared to Alternative 2 using the low and high estimates of potential gross revenue under each alternative as compared to the baseline, Alternative 1. A detailed discussion of low and high estimates is found in section 4.12.2.1 of this document, and further in section 1.3.3.1 of Appendix C. The high estimates for Alternatives 2 and 3, which represent the potential gross revenues from the harvest of all of the TAC for each alternative, are substantially different for the two alternatives, with Alternative 2's TAC level being 28% less than Alternative 1 and that for Alternative 3 only 2% reduced. Both Alternatives 2 and 3, however, have a large amount of potential gross revenue "at risk" due to critical habitat restrictions, such that the high estimate for Alternative 2 is in fact at the same level as the low estimate for Alternative 3. Alternative 3 can therefore be gauged using Alternative 1 and 2 (high) estimates.

The probable reduction in groundfish fishery income and revenue in this alternative along with reductions in the productivity of other fisheries will likely impact employment and income in those regions and communities heavily dependent on commercial fishing. The highly restrictive time and area closures in this alternative close fishing in many productive areas; although the TAC level remains relatively similar to the baseline Alternative 1, the likelihood that fishermen will be able to find sufficient alternative productive fishing areas in order to meet the TAC is highly uncertain. The potential for significant decline in the fisheries for pollock, Pacific cod and Atka mackerel under this alternative are high; should the outcome veer toward the low estimate of productivity, the implications would be significantly adverse. With concurrent declines in crab and salmon fisheries, processors would most likely need to reduce workforce resulting in sharp declines in employment and income. This would be exacerbated by unemployment in the catcher vessel sectors from vessels if high operation costs and declines in other fisheries make it difficult to remain operational long enough to invest the time necessary to seek out productive new fishing grounds.

In areas such as the Alaska Peninsula and the Aleutian Islands, and Kodiak regions, it is unlikely that any other economic development would be sufficient to offset the potential adverse cumulative effects of the combined fisheries declines. Foreseeable infrastructure, military clean-up and construction, and tourism activities are not envisaged on a sufficient scale to affect reductions in the fisheries sector.

On a community level, Alternative 3 also has significant impacts to individual communities subject to critical habitat closures in their immediate area. Such closures would predominantly affect small boats with limited range, and would potentially affect their economic viability and safety.

Alternative 3's low estimate potential would be proportionately negative to regions and communities in terms of the reduction of municipal and state revenue. For those regions heavily dependent on revenue from taxes assessed inshore, the decline would be significantly adverse. The community of Unalaska, however, which receives much of its revenue from transfer taxes (assessed to at-sea processors which, being more mobile, would be more able to overcome the critical habitat restrictions), would be less severely affected than other commercial fishery communities.

Cumulative Effects of Alternative 4 - Area and Fishery Specific Approach

Cumulative effects of Alternative 4 are similar to the baseline case (Table 4.13.13-9). The direct and indirect indicators place the alternative at Conditionally Significant adverse, due to the fact that the low estimate falls just outside the 5% reduction range for all indicators.

Employment and income will be cumulatively affected to the degree that salmon and crab fisheries are important in the region or community. The decline in those fisheries, as discussed in Alternatives 1 and 2, will conjoin with the predicted marginal decline in the pollock, Pacific cod and Atka mackerel fisheries to produce a cumulative adverse effect. This will also apply to secondary employment and economic activity, and to state and municipal revenue from the fisheries.

Small boat fleets from individual communities may be adversely affected to a significant degree through Alternative-imposed restrictions in the immediate area of the community, which affect the economic viability of the vessels who have to travel a much greater distance in order to exit the restricted area.

Option 1 - Chignik Small Boat Exemption

The cumulative effects analysis for Alternative 4 is not substantively different with the adoption of Option 1. The small boat fleet of the community of Chignik would be directly benefitted by the exemption, and the adverse cumulative effects for this community would be proportionately less.

Option 2 - Unalaska Small Boat Exemption

The cumulative effects analysis for Alternative 4 is not substantively different with the adoption of Option 2. The small boat fleet of the community of Dutch Harbor would be directly benefitted by the exemption, and the adverse cumulative effects for this community would be proportionately less.

Option 3 - Gear Specific Zones for GOA Pacific Cod Fisheries

The adoption of Option 3 does not substantively change the cumulative effects analysis for Alternative 4. Communities with a higher proportion of smaller vessels would benefit from the more exclusive fishing zones; those with a higher proportion of larger vessels may feel some adverse impact as vessel owners will need to search out new fishing grounds to replace those utilized closer inshore. The overall impact, however, should be insignificant.

Cumulative Effects of Alternative 5 - Critical Habitat Catch Limit Approach

Cumulative effects of Alternative 5 are significantly adverse in the light of other fishery trends, particularly to those regions and communities heavily dependent on commercial fishing (Table 4.13.13-10).

Alternative 5 was compared to Alternative 1 using the low and high estimates of potential gross revenue. A detailed discussion of low and high estimates is found in Section 4.12.2.1 of this document, and further in Section 1.3.3.1 of Appendix C. The high estimates for Alternatives 5 and 3, which represent the potential gross revenues from the harvest of all of the TAC for each alternative, are essentially similar for the two alternatives, with both TAC levels 2% reduced from the baseline Alternative 1. Alternative 5, however, has substantially less potential gross revenue "at risk" due to critical habitat restrictions, such that the low estimate for Alternative 5 is only 10% less than Alternative 1. Alternative 5 can therefore be gauged using Alternative 3 (high) and an intermediary low estimate between Alternatives 1 and 3 (low).

Alternative 5 has a moderate differential between low and high estimates, and has been rated Conditionally Significant on its direct and indirect indicators. Practically, this means that should the gross revenue of the fishery end up toward the high estimate, the direct and indirect effects would be marginally adverse, whereas if the outcome were lower the effects would be moderately adverse. In either case, the cumulative effect is adverse due to the declining influence of other fisheries; only degree differentiates the two scenarios.

In the brightest aspect, the alternative would have similar cumulative impacts as Alternative 1. Should the gross revenue outcome veer more towards the low estimate, however, reductions employment and income in the regions and communities would be more important. It is unlikely that the alternative would cause a serious viability question with most processing plants, although the potential for a reduction in productivity exists. This would result directly in a decrease in municipal and state revenues to the community and region.

Table 4.13-47 Regions and Communities – Cumulative Effects for Alternative 1

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Developmt Activities	Other Revenue Payments/Sources		
Total regionally owned CV harvest volume (indicator of direct participation by regional residents in the harvest sector)	S ⁺		-	-			Y	Y-
Total ex-vessel value paid by shorebased processors in the region (indicator of level and changes in level of the local fisheries related tax base)	S ⁺		-	-	0	-	Y	Y-
Total shorebased processing volume in the region (indicator of the level of activity taking place on shore in the region)	S ⁺		-	-			Y	Y-
Total harvesting and processing payments to labor accruing in the region (indicator of the value of the fishery employment to the residents of the region)	S ⁺		-	-	0		Y	Y-
Total harvesting and processing employment accruing to the region (indicator of the total groundfish fisheries employment in the region)	S ⁺		-	-	0		Y	Y-

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-48 Regions and Communities – Cumulative Effects for Alternatives 2 and 3

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Total regionally owned CV harvest volume (indicator of direct participation by regional residents in the harvest sector)	S-		-	-			Y	Y-
Total ex-vessel value paid by shorebased processors in the region (indicator of level and changes in level of the local fisheries related tax base)	S-		-	-	0	-	Y	Y-
Total shorebased processing volume in the region (indicator of the level of activity taking place on shore in the region)	S-		-	-			Y	Y-
Total harvesting and processing payments to labor accruing in the region (indicator of the value of the fishery employment to the residents of the region)	S-		-	-	0		Y	Y-
Total harvesting and processing employment accruing to the region (indicator of the total groundfish fisheries employment in the region)	S-		-	-	0		Y	Y-

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-49 Regions and Communities – Cumulative Effects for Alternative 4

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Total regionally owned CV harvest volume (indicator of direct participation by regional residents in the harvest sector)	I		-	-			Y	Y-
Total ex-vessel value paid by shorebased processors in the region (indicator of level and changes in level of the local fisheries related tax base)	I		-	-	0	-	Y	Y-
Total shorebased processing volume in the region (indicator of the level of activity taking place on shore in the region)	I		-	-			Y	Y-
Total harvesting and processing payments to labor accruing in the region (indicator of the value of the fishery employment to the residents of the region)	I		-	-	0		Y	Y-
Total harvesting and processing employment accruing to the region (indicator of the total groundfish fisheries employment in the region)	I		-	-	0		Y	Y-

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

Table 4.13-50 Regions and Communities – Cumulative Effects for Alternative 5

Direct/Indirect Effects of Groundfish Fishery		External Effects					Cumulative Effect Y/N	Conditionally Significant Y/N
Category	Ranking	Human Controlled						
		Foreign Fisheries	Other Federal Fisheries	State Fisheries (salmon, crab, cod)	Other Economic Devlpmt Activities	Other Revenue Payments/Sources		
Total regionally owned CV harvest volume (indicator of direct participation by regional residents in the harvest sector)	CS ⁻		-	-			Y	Y-
Total ex-vessel value paid by shorebased processors in the region (indicator of level and changes in level of the local fisheries related tax base)	CS ⁻		-	-	0	-	Y	Y-
Total shorebased processing volume in the region (indicator of the level of activity taking place on shore in the region)	CS ⁻		-	-			Y	Y-
Total harvesting and processing payments to labor accruing in the region (indicator of the value of the fishery employment to the residents of the region)	CS ⁻		-	-	0		Y	Y-
Total harvesting and processing employment accruing to the region (indicator of the total groundfish fisheries employment in the region)	CS ⁻		-	-	0		Y	Y-

S = Significant, CS = Conditionally Significant, I = Insignificant, U = Unknown, + = positive, - = negative

4.14 Special Considerations Regarding Impacts of Options 1-3 under Alternative 4

There are three options for closure areas applicable to the GOA Pacific cod fisheries under Alternative 4. These areas are shown in Figure 2.3-7 (map packet). A discussion of these options is provided below.

Options 1 and 2

These options would establish special fishing zones for fixed gear vessels under 60' in the Chignik area and the Dutch Harbor area. The objective of these options would be to provide continued access to these areas by smaller vessels fishing for Pacific cod, which presumably deliver to local processors. Specifically, these options are as follows:

Option 1: Chignik small boat exemption. This option would establish a fishing zone in the Chignik area (area 4) for non-trawl gear out to ten (10) miles from Castle Cape to Foggy Cape for vessels under 60 ft.

Option 2: Unalaska small boat exemption (Preferred). This option would establish a fishing zone for Pacific cod in the Dutch Harbor area (area 9) for jig, and longline catcher vessels less than 60 ft. This fishing zone would encompass all waters of the Bering Sea and Area 9 south of the line connecting the point 3 nm north of Bishop Point to Cape Tanak. This option would include a 10 nmi radius closure around the Bishop Pt haulout in Area 9. This area would fish under a 250,000 lbs. Pacific cod harvest cap.

The social and economic impacts of these options were fully analyzed in Section 4.12, and in Appendices C and F. Of the vessels owned by residents of Unalaska/Dutch Harbor, a total of 7 catcher vessels made groundfish landings (worth a total of \$100,000) using fixed gear in the year 2000. Of these, 2 vessels used longline gear and jig gear, and 5 vessels used only jig gear. The potential benefits to be gained by these vessels via the exemption allowed under option 2 appear to be small (average of \$14,000 per vessel). Additionally, any benefits afforded by option 2 to vessel owners from Unalaska may be further diminished by other qualified vessels participating in this area and competing for the 250,000 pound Pacific cod harvest limit. Note that there were 23 vessels under 60 feet long that participated in the Bering Sea Pacific cod target fishery in the year 2000.

Fishery data from fish tickets indicated that in the Chignik area, a majority of the Pacific cod landed by vessels under 60' using fixed gear was taken within state waters. In 1999, the highest year of participation, 21 vessels made combined landings from state and federal water groundfish fisheries, totaling \$1.4 million. Virtually all the landings were Pacific cod, of which 95 percent was harvested with pots and 5 percent by jig gear. Of the pot gear, 71 percent was made from state waters and 29 percent from federal waters. If it is assumed that the landings from federal waters cannot be 'made up' in state water fisheries, the forgone revenue to Chignik pot fisheries is about \$386,000. Public testimony at the October 2001 Council meeting indicated that there was only one vessel that currently fished exclusively in federal waters using pot gear. Environmental impacts of these options relative to the baseline Alternative 4 are likely to be insignificant, as these areas are relatively small and the catches would also be relatively small. The direct and indirect effects (including effects on Steller sea lions) of implementing these options would not be substantially different than for the baseline Alternative 4. The cumulative effects analysis indicated that the adoption of either Option 1 or Option 2 were not substantively different than the baseline Alternative 4. The small boat fleet of the communities of Chignik and Dutch Harbor would be directly benefitted by the exemption, and the adverse cumulative effects for this community would be proportionately less.

No additional management issues are raised by this option. One slight benefit for enforcement is that enforcement would know, without having to check what species the vessel was targeting (e.g., halibut, sablefish), that all fixed gear vessels under 60' would be allowed within the area.

One consideration, however, is that adopting these options would reduce the utility of using the areas as a scientific control area for broad-scale monitoring studies that have been contemplated by NMFS. Without these options, all of area 9 (as well as the Seguam area) would be closed to all directed fishing for pollock, Pacific cod, and Atka mackerel by all gear types. Area 4 would be closed to all but jig gear. Closures to directed fishing by all (or nearly all) gear types may serve as control sites for gaining understanding of the efficacy of implementing these fishery management measures designed to protect Steller sea lions. Nevertheless, it should be noted that the Council's Independent Scientific Review Panel questioned the experimental design of broad-scale monitoring programs and the likelihood of being able to derive conclusions from them.

Option 3

This option would establish gear specific zones for GOA Pacific cod fisheries. Specifically, this option would establish zones (0-3 nm, 3-12 nm, 12-20 nm, and > 20 nm), as measured from land, from which vessels of certain sizes, and using certain listed gear types could participate.

0-3 nm	3-12 nm	12-20 nm	Outside 20 nm
pot vessels with 60 pot limit, and jig vessels with a 5 machine limit	pot vessels with 60 pot limit, jig vessels with a 5 machine limit, and longline vessels < 60'	all pot vessels, all jig vessels, and all longline vessels	all vessels and gears

The objective of this option would be to move selected fisheries further away from shore (not just from rookeries and haulouts) to reduce the potential for competition of fisheries with Steller sea lions. The idea behind this option was that closure bands, as measured from the distance from shore, could potentially reduce interactions of the Pacific cod fisheries with Steller sea lions when they move between haulouts and/or rookeries.

In general, the impacts of implementing Alternative 4, option 3, would be similar to the impacts of implementing the zonal approach taken for Pacific cod fisheries under Alternative 2 (including the prohibition on trawling within critical habitat). The economic impacts of this option were analyzed in Appendix C. Trawl vessels, and to a lesser extent the larger longline vessels, would be required to fish further from port, regardless of how close they would be to haulouts and rookeries. As discussed in previous sections for Alternative 2, economic costs of moving the fleets further offshore include direct costs of reduced catches or forgone TAC, and operational costs associated with reduced catch rates, additional travel time, etc.

A prohibition on fishing for cod within 20 nm of land raises social, economic, allocative, and safety issues. Trawl vessels may be unable to catch Pacific cod in quantity in areas outside of 20 nm. As shown in Table 2.5-10, about 49% of the trawl Pacific cod catch in directed fisheries came from within 20 nm of land. A closer examination of the data suggest that option 3 would impact the smaller vessel trawl fleet of the western GOA (primarily vessels from Sand Point) more than the central GOA (primarily vessels from Kodiak). About 70% of the Pacific cod trawl catch in the western GOA came from within 20 nm, and a majority of that catch was made with trawl vessels < 60'. It is unlikely that trawl vessels will be able to economically recoup this

catch outside of 20 nm. Consequently, the catch would likely be reallocated from these vessels to vessels fishing with pot gear and longline vessels fishing in potentially more productive nearshore fishing areas. Safety issues may be of concern as well, particularly for small trawl vessels hailing from Sand Point and Kodiak attempting to target Pacific cod.

In most cases, the overall environmental impacts of adding this option would not be substantially different from the baseline Alternative 4. Nevertheless, some environmental effects due to shifting the locations of Pacific cod fleet could occur. For example, shifting the trawl effort away from shore may reduce the potential for competitive interactions of the GOA Pacific cod fisheries with Steller sea lions, and may reduce the potential for habitat impacts in nearshore environments. Note, however, that option 3 would allow pot vessels and jig vessels to fish within 3 nm from shore, and thus reduce or even negate potential environmental benefits afforded by this option.

The management complexity of option 3 are similar to the zonal approach detailed under Alternative 2. Monitoring would require that the target species be determined. For example, trawl vessels would still be allowed to fish within 20 nm from shore for all other species except for Pacific cod. This creates a situation where an enforcement patrol would somehow need to determine what species a vessel may be targeting when fishing within the 20 nm band. One additional management issue raised by this option is that the baseline for land would need to be defined, and the 20 nm boundary established (the 3 nm EEZ boundary and the 12 nm territorial sea boundaries are already on maps).

The adoption of Option 3 does not substantively change the cumulative effects analysis for Alternative 4. Communities with a higher proportion of smaller vessels would benefit from the more exclusive fishing zones; those with a higher proportion of larger vessels may feel some adverse impact as vessel owners will need to search out new fishing grounds to replace those utilized closer inshore. The overall impact, however, should be insignificant.

Chapter 5 List of Preparers

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Tamra Faris, Fisheries Biologist, Alaska Regional Office, NMFS, Juneau, Alaska. Regional Planner and NEPA Coordinator. Oversaw compilation of this analysis including assigned NMFS preparers, served as contract officer representative for portions of analysis done under contract, conducted scoping, prepared the analysis outline, drafted Purpose and Need, reviewed and coached preparers, conducted workshops and conference calls with analysts, oversaw editing and document assembly. Previous assignments with fishery management NEPA analyses include the Alaska Groundfish Programmatic SEIS, the Alaska Groundfish Total Allowable Catch Setting SEIS, and numerous environmental analyses on fisheries management actions. Twenty-five years experience with the Federal Government working with marine fisheries conservation in Alaska. *B.S. University of Alaska, M.S. University of Washington.*

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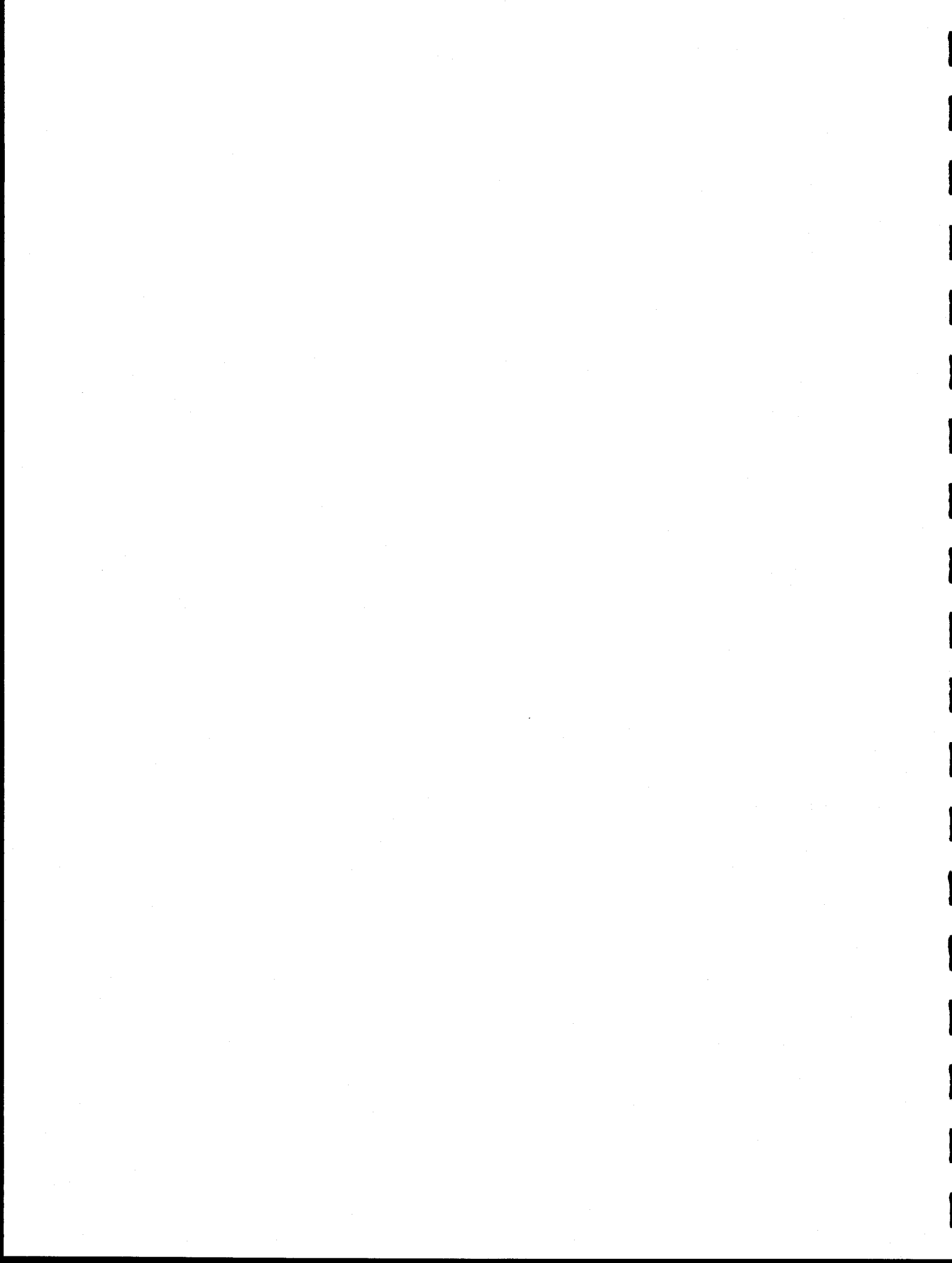
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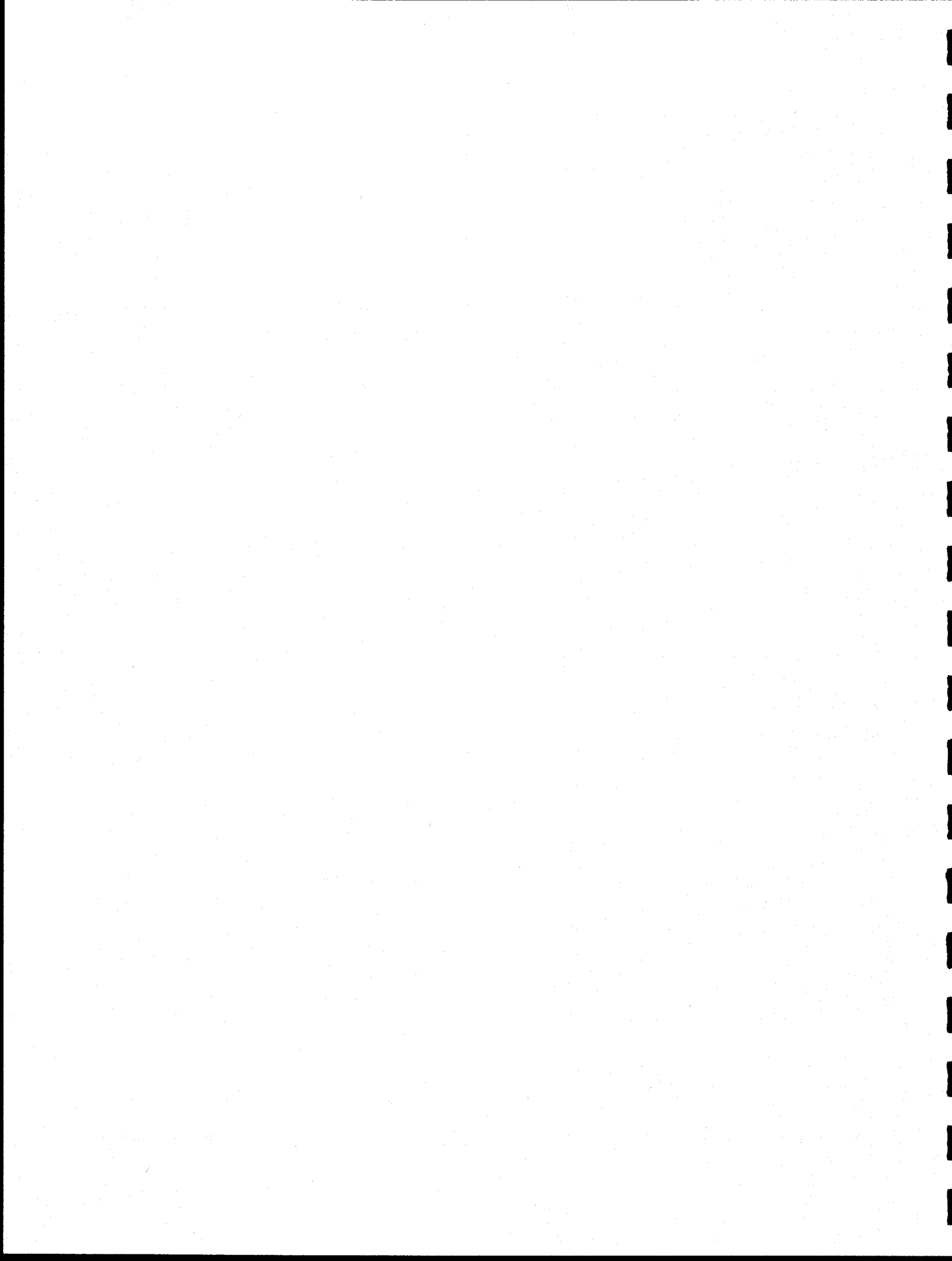
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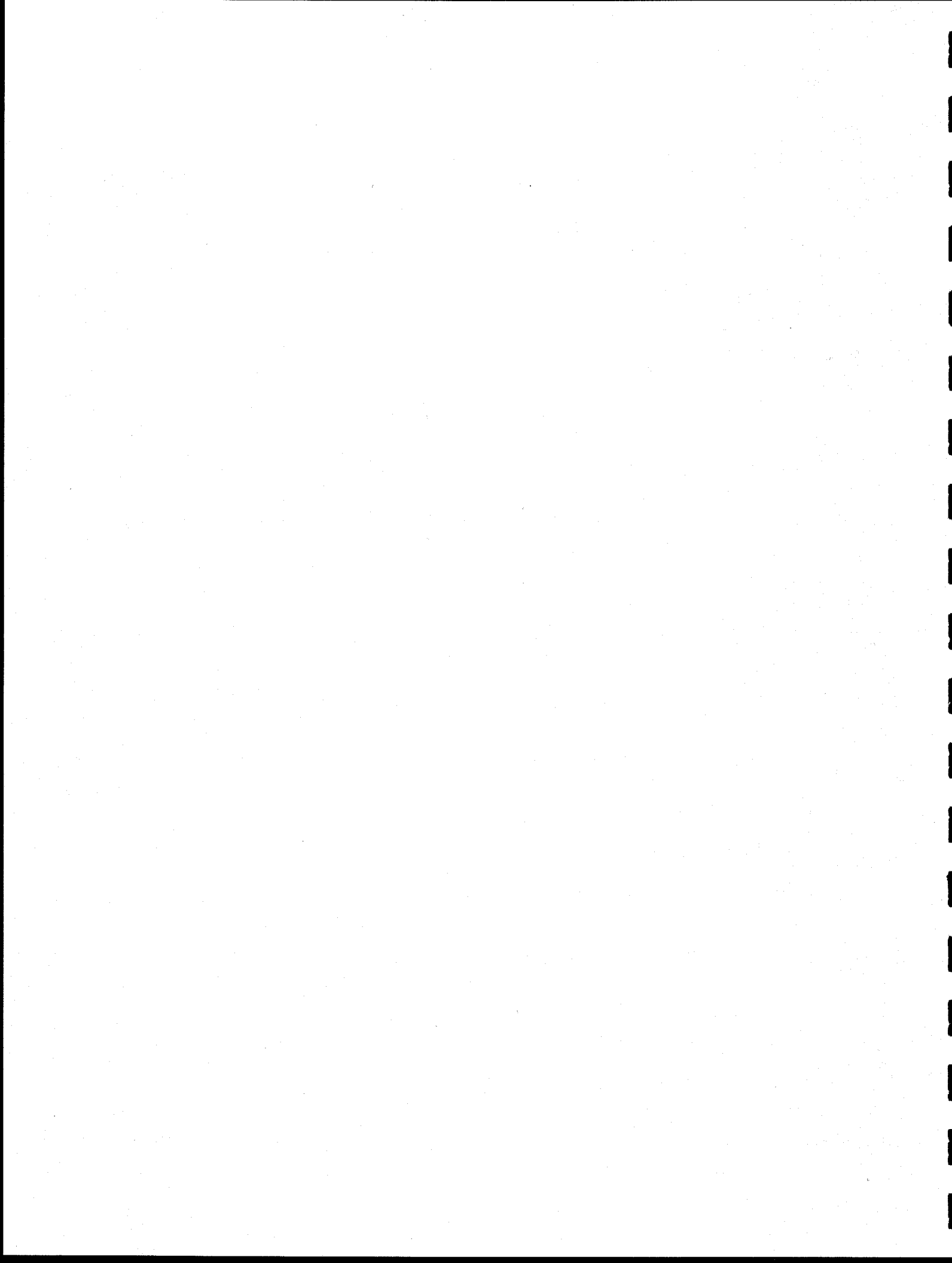
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